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MONITORING COSTS AND THEIR IMPLICATIONS FOR DIRECT DISCHARGERS IN THE ONTARIO MINERAL INDUSTRY: GROUP "B" INDUSTRIAL MINERALS SECTOR

NOVEMBER 1989

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Ontario

Jim Bradley
Minister

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MONITORING COSTS AND THEIR IMPLICATIONS FOR DIRECT DISCHARGERS IN THE ONTARIO MINERAL INDUSTRY: GROUP "B" INDUSTRIAL MINERALS SECTOR

Report prepared for:
Ministry of the Environment

Report prepared by:
Socio-Economics Section
Policy and Planning Branch
Corporate Resources Division

NOVEMBER 1989

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REQUEST FOR COMMENTS AND SUGGESTIONS ON

MONITORING COSTS AND THEIR IMPLICATIONS FOR DIRECT DISCHARGERS IN THE ONTARIO MINERAL INDUSTRY: GROUP "B" INDUSTRIAL MINERALS SECTOR

(DRAFT NO. 2, DATED NOVEMBER 1989)

Comments and suggestions will be used to improve subsequent drafts of this report, and similar reports on other sectors, in terms of analysis, technical accuracy, and readability.

Please return this sheet and any comments to:

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ABSTRACT

- Estimates of the incremental costs to Ontario's industrial minerals plants which are direct dischargers subject to the MISA Monitoring Regulation are derived and summarized.

- A total of 72 firms with 125 Ontario plant locations are subject to the MISA Monitoring Regulations for the industrial minerals sector.

- For the purposes of the MISA program, the industrial minerals sector is comprised of nine industry categories:

  (a) Cement, with six plants;
  (b) Chemical Lime, with six plants;
  (c) Clay and Shale, with five plants;
  (d) Graphite, with two plants;
  (e) Gypsum, with three plants;
  (f) Magnesium, with one plant;
  (g) Quarries, with 94 plants;*
  (h) Sand and Gravel, with six plants; and
  (i) Talc, with two plants.

  * A representative sample of 20 quarries has been selected for monitoring. The incremental costs of the Monitoring Regulations to these quarries will be shared by all 94 quarries.

- Capital and operating and maintenance (O & M) costs are estimated by firm for each of six key monitoring activities:

  - sampling requirements (including costs associated with the transport of effluent samples from plants to labs)
  - flow measurement
  - routine analyses
  - characterization analyses
  - toxicity testing
  - reporting

- Capital costs are estimated to be $333,000 ± $66,600 using a ± 20% confidence measure.

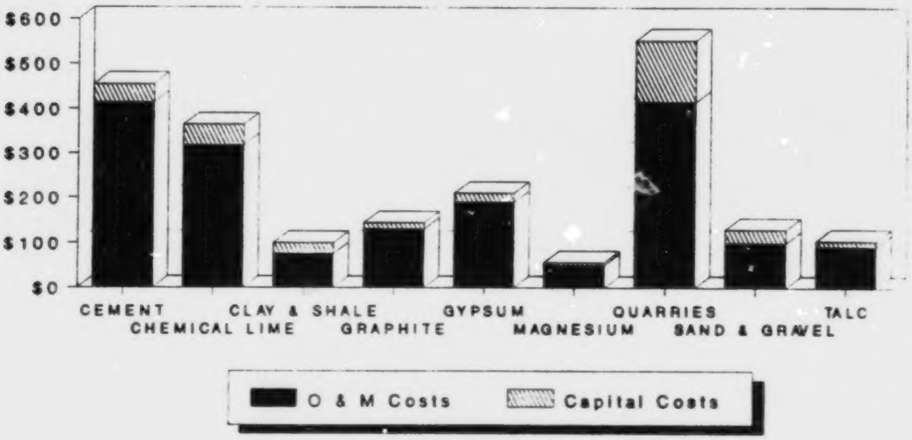
  - Reporting requirements account for 97% of total capital costs, and flow measurement devices account for the remainder.

ABSTRACT (Continued)

- Operating and maintenance costs over the 12-month period of the regulation are estimated to be \$1.8 million ± \$357,000 using a ± 20% confidence measure.
  - Analytical testing accounts for 49% of the total.
  - Sampling, including transport of effluent samples to labs, accounts for 38% of total costs.
  - Of the remaining O & M costs, flow measurement accounts for 9% and reporting costs account for 4%.
- Monitoring requirements for the industrial minerals sector involve category-specific requirements and are dependent, in part, on the number and type of sample points or effluent streams that are currently identified at each plant.
- Estimates of total and average costs of monitoring by industry category are presented in Figure 1.
  - The Quarries category accounts for the largest share of total costs for the sector, at 26.2%, but the plants in this category face the lowest average costs per plant, at \$5,900.
  - The Cement category accounts for 21.5% of total costs for the sector and has the highest anticipated average cost per plant, at \$75,900.
- Total incremental monitoring cost ranges for each plant vary from a low of \$4,000 to \$6,100 for most plants in the Quarries category to a high of \$66,800 to \$100,100 for North Coast Industries Ltd. in the Graphite category.
- The estimated costs of the proposed monitoring requirements are compared to costs that would result under several alternative monitoring options.
  - If all 94 plants in the Quarries category were required to undertake monitoring activities, rather than just the 20 representative sites, costs per plant would increase by at least \$17,000 for most plants in this category; total costs would increase by about \$1.6 million.

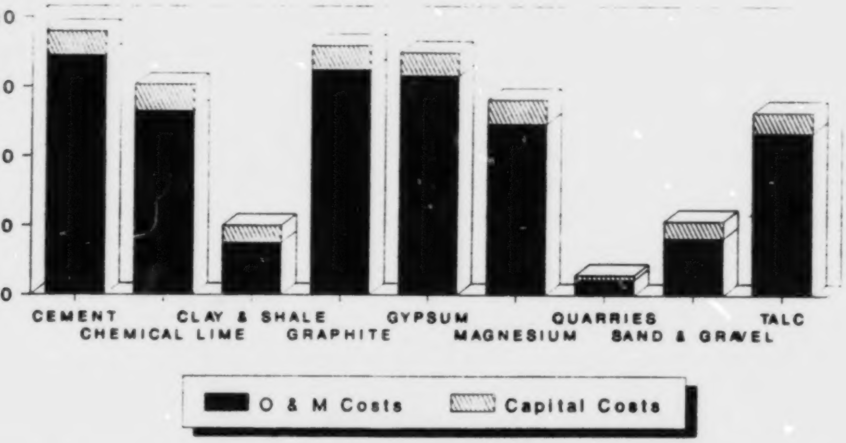
Figure 1: Total and Average Costs of Monitoring by Industry Category

TOTAL COST BY INDUSTRY CATEGORY
(IN $1,000'S)



Total Cost to Sector: $2.1 Million

AVERAGE COST BY INDUSTRY CATEGORY
(IN $1,000's)



Source: Table 3.8

ABSTRACT (Continued)

  - For those plants with settling ponds in the Quarries and the Sand and Gravel categories, to require composite rather than grab samples would increase costs by about $3,120 per plant. This amounts to an increase of $78,000 for this sector based on representative sampling in the Quarries category or an increase of $309,000 if all quarries were required to monitor.

  - If all plants in the sector were allowed to take grab samples rather than composite samples, the 22 plants that would be affected would each save about $9,400 for a total saving of about $206,000 for the sector. However, there would be an increased risk that the information obtained would be suspect.

- Additional costs that are related to, but not required by, the Monitoring Regulations have been and are expected to be borne by firms in the industrial minerals sector.

  - Costs have been incurred for pre-regulation monitoring and for meetings and studies related to regulation development, and additional costs may result for the analysis of intake water. However, no estimates of these or similar costs have been provided.

- The cost estimates are not definitive, but indicate the relative costs among different industry categories and the total costs for individual plants and companies.

- While it is desirable to carry out financial analyses on a plant by plant basis, data were not available at this level of operation. Consequently, the analyses are based on publicly available information for 11 firms that own 28 plants in the sector and for industry categories as a whole.

- Analyses of financial impacts on selected financial performance indicators for industrial minerals firms indicate that the financial effects appear not to

ABSTRACT (Continued)

burden significantly any of the 11 firms for which data are available.

  - Estimates of incremental capital costs for each firm are compared with actual expenditures for each of the past six years.
  - Incremental O & M costs for each firm are computed as a percentage of after-tax profits or earnings for each year.
  - Calculations are made of the degree to which incremental O & M costs, adjusted to account for the corporate tax rate, would reduce each firm's rate of return on capital employed.

- The industrial minerals sector is sensitive to national business conditions, and especially to construction activity.
  - The smaller plants and firms in the sector may be especially hard hit by a slowdown in construction activity; business conditions should be carefully monitored.

1.0 BACKGROUND AND PURPOSE OF REPORT

1.1 Program Objectives

The Municipal-Industrial Strategy for Abatement (MISA) is intended to achieve the "virtual elimination of toxic contaminants in municipal and industrial discharges into waterways." (Ontario Ministry of the Environment, 1986)

MISA consists of three broad components:

1. Development and promulgation of Regulations which will specify (a) contaminant monitoring requirements, and (b) effluent limits.
2. Development of these effluent limits based on best available technology, economically achievable (BATEA) or water quality impacts.
3. Implementation of abatement programs and enforcement activities.

Economic assessments are a fundamental component of the MISA program. The intent of the economic analyses is to determine the magnitude of the costs and benefits of various regulations and other program elements, reveal the distribution of these costs and benefits, evaluate the economic effects and implications of the potential costs and benefits and where possible, determine the least-cost mechanisms for achieving program objectives (Ontario Ministry of the Environment, 1987a).

1.2 Sectors Affected by MISA

Regulations will be developed for all industrial establishments whether they discharge wastewaters directly into lakes and rivers or indirectly via municipal sewer systems. The first elements of the MISA program to be implemented are monitoring regulations on industrial establishments that discharge wastewaters directly into provincial waterways. Table 1.1 lists the industrial sectors for which monitoring regulations are being developed. Approximately 315 plants and mines in the province will be subject to monitoring regulations.

Plants which are not subject to the direct discharge monitoring regulations eventually will be

TABLE 1.1

INDUSTRIAL SECTORS SUBJECT TO MISA DIRECT DISCHARGE REGULATIONS

Industrial Sector	SIC Nos.	Approximate Number of Plants in Ontario	Direct Discharger Plants or Sites under MISA Regulation
Metal Mining and Refining	0111-0619	*	67
Pulp, Paper and Paper Board	2711-2712	41	27
Iron and Steel	2911-2921	57	7
Metal Casting Foundries	2941-2999	300**	13
Petroleum Refineries	3611	7	7
Inorganic and Organic Chemical Manufacturing	3711-3799	840	41***
Electric-Power and AECL	4911	89	27
Industrial Minerals (quarries, cement, brick, lime, sand and gravel, dolomite)	062,081-2 351-2, 358-9	3,000**	125

* Unknown

** Approximate number

*** 4 plants in SIC 1800-1897 were included in the Organic Chemical Manufacturing Sector for purposes of the MISA Monitoring Regulation.

required to implement additional monitoring under a comprehensive sewer use program (Ontario Ministry of the Environment, 1988).

1.3 Effluent Monitoring Regulation for Ontario's Mineral Industry: Group "B" Industrial Minerals Sector

The first phase of the MISA regulatory program is the promulgation of monitoring regulations for all plants or establishments within each industrial sector which discharge wastewaters directly into the natural environment.

The proposed Monitoring Regulation for industrial minerals plants in Ontario is stated and discussed in The Development Document for the Draft Effluent Monitoring Regulation for the Ontario Mineral Industry: Group "B" - Industrial Minerals Sector (Ontario Ministry of the Environment, 1989a). This proposed regulation constitutes the basis of this report.

An Industrial Minerals Sector has been defined for purposes of the MISA regulatory programs and consists of firms which are involved primarily in the following non-metallic mineral mining and manufacturing industries:

(a) Cement, with six plants;
(b) Chemical Lime, with six plants;
(c) Clay and Shale, with five plants;
(d) Graphite, with two plants;
(e) Gypsum, with three plants;
(f) Magnesium, with one plant;
(g) Quarries, with 94 plants;
(h) Sand and Gravel, with seven plants; and
(i) Talc, with two plants.

Seven three-digit Standard Industrial Classification (SIC) categories are represented in this sector: 062, 081, 082, 351, 352, 358, and 359.

Chapter 2 of this report presents a profile of the Industrial Minerals Sector. Appendix B provides profiles of each of the industry categories in the sector.

A total of 72 firms with 125 Ontario plant locations in this sector are subject to the regulation. The plants in each industry category are listed by company in Table 1.2. The four-digit SIC codes corresponding to each category are also indicated in this table.

Monitoring requirements for the direct dischargers in Ontario's industrial minerals sector are specified in two regulations:

1. "Effluent Monitoring - General" which specifies common sampling, analysis, toxicity testing, flow measurement, recording and reporting protocols and procedures for all MISA sectors; and
2. "Effluent Monitoring - Ontario Mineral Industry: Group "B" Industrial Minerals Sector" which defines monitoring requirements specific to the industrial minerals sector.

The monitoring requirements specified in the Regulations have been developed through negotiations with industry representatives and with representatives from the federal government through a Joint Technical Committee (JTC).

The "Effluent Monitoring - General" Regulation came into force June 7, 1988 and will continue to apply to each industrial sector (Government of Ontario, 1988).

The industrial minerals sector regulation will come into force five months after it is promulgated and will continue in effect during the subsequent 12-month period. It will be terminated at the end of the 17-month period. At this writing, it is not known precisely when the sector-specific monitoring regulation will be promulgated.

Many monitoring activities will then terminate under a "listing/delisting" protocol while some monitoring requirements will be specified in a subsequent "Effluent Limits Compliance Regulation" for this sector. Any monitoring activities that are required by existing control orders or certificates of approval will continue to apply at the end of 17-month period.

1.4 Purpose and Objectives of Present Report

This report is intended to present estimates of the potential incremental costs to each of the plants in Ontario's industrial minerals sector which are subject to the requirements of the sector

TABLE 1.2

ONTARIO INDUSTRIAL MINERALS PLANTS SUBJECT TO THE MISA MONITORING REGULATIONS

Company - Plant	Location
CEMENT CATEGORY (SIC Code 3521)	
1. LaFarge Canada Inc., Cement Plant/Limestone Quarry	Bath
2. LaFarge Canada Inc., Cement Plant/Limestone Quarry	Woodstock
3. Lake Ontario Cement, Cement Plant/Limestone Quarry	Picton
4. St. Lawrence Cement, Cement Plant	Mississauga
5. St. Marys Cement Company, Cement Plant/Limestone Quarry	Bowmanville
6. St. Marys Cement Company, Cement Plant/Limestone Quarry	St. Marys
CHEMICAL LIME CATEGORY (SIC Code 3581)	
7. BeachviLime Limited [1], Lime Plant/Limestone Quarry (East Plant)	Beachville
8. BeachviLime Limited [1], Lime Plant/Limestone Quarry (West Plant)	Beachville
9. Guelph DoLime Limited [2], Lime Plant/Dolomite Quarry	Guelph
10. Reiss Lime Co. of Canada Ltd., Lime Plant	Spragge
11. Steetley Quarry Products Inc. [3], Lime Plant/Limestone Quarry	Flamborough
12. Stelco Chemical Lime Works, Lime Plant/Limestone Quarry	Ingersoll
CLAY AND SHALE CATEGORY (SIC Codes 0815, 3511)	
13. Brampton Brick Ltd., Brick Plant/Clay Pit	Brampton
14. Canada Brick Company [4], Brick Plant/Clay Pit	Burlington
15. Canada Brick Company [4], Brick Plant/Clay Pit	Cooksville
16. Canada Brick Company [4], Brick Plant/Clay Pit	Gloucester
17. Canada Brick Company [4], Brick Plant/Clay Pit	Streetsville
GRAPHITE CATEGORY (SIC Codes 0629, 3591)	
18. Cal Graphite Corporation, Graphite Mine/Mill	Kearney
19. North Coast Industries Ltd., Graphite Mine/Mill	Maria Twp.
GYPSUM CATEGORY (SIC Codes 0623, 3593)	
20. CGC Limited, Gypsum Mine/Processing Plant	Hagersville
21. Domtar Construction Materials, Gypsum Mine/Processing Plant	Caledonia
22. Westroc Industries Limited, Gypsum Mine	Drumbo
MAGNESIUM CATEGORY (SIC Code 0629)	
23. Timminco Ltd. (Metals Division), Dolomite Quarry/Magnesium Plant	Haley Station
QUARRIES CATEGORY (SIC Codes 0811, 0812)	
24. Amherst Quarries (1969) Ltd., Limestone Quarry	Amherstburg
25. B&M Carriers Ltd. [NM], Limestone Quarry	N. Plantagenet
26. B&M Carriers Ltd. [NM], Limestone Quarry	S. Plantagenet
27. Beaver Road Builders Ltd. [NM], Rideau Road Quarry	Gloucester
28. Bertrand & Frere Construction Co. Ltd. [NM], Limestone Quarry	L'Original
29. Bertrand & Frere Construction Co. Ltd. [NM], Limestone Quarry	Longueil Twp.
30. Bertrand & Frere Construction Co. Ltd. [NM], Limestone Quarry	S. Plantagenet
31. Thomas Cavanagh Construction Ltd. [NM], Limestone Quarry	Ashton
32. Cayuga Materials & Construction Co. Ltd. [NM], Limestone Quarry	Cayuga
33. Cedarhurst Quarries & Crushing Ltd. [NM], Limestone Quarry	Coboconk

(...Continued)

TABLE 1.2 (Continued)

Company - Plant	Location
QUARRIES CATEGORY (Continued)	
34. Allan G. Cook Limited, Limestone Quarry	Coldwater
35. Cornwall Gravel Co. Ltd., Limestone Quarry	Cornwall
36. Cornwall Gravel Co. Ltd., Clarence Quarry	Cambridge Twp.
37. Cornwall Gravel Co. Ltd. [NM], Winchester Quarry	Winchester
38. Cruickshank Construction Ltd. [5,NM], Limestone Quarry	Amherstview
39. Cruickshank Construction Ltd. [5], Limestone Quarry	Kingston
40. Cruickshank Construction Ltd. [6,NM], Limestone Quarry	Green Valley
41. Cruickshank Construction Ltd. [NM], Leslie Cruickshank Quarry	Lancaster
42. Cruickshank Construction Ltd. [NM], Limestone Quarry	Williamsburg
43. Cruickshank Construction Ltd. [NM], Limestone Quarry	Kenyon Twp.
44. Dechan Construction Ltd. [NM], Miller Paving	Beckwith Twp.
45. James Dick Construction Ltd. [NM], James Dick Aggregates	Brechin
46. George W. Drummond Ltd. [NM], Limestone Quarry	Nepean
47. Dufferin Aggregates [7], Limestone Quarry	Milton
48. Dunnville Rock Products Ltd. [NM], Limestone Quarry	Dunnville
49. Dymond Clay Products Ltd. [NM], Limestone Quarry	Haileybury
50. Flamboro Quarries Ltd., Limestone Quarry	Flamborough
51. Fowler Construction Company Ltd. [NM], Broken Front Quarry	Twp. of Mara
52. Francon Ottawa Div. of Lafarge Canada Inc., Limestone Quarry	Gloucester
53. Gormley Aggregates Ltd. [NM], Limestone Quarry	Buckhorn
54. Gormley Aggregates Ltd., Limestone Quarry	Carden Twp.
55. Griffin Brothers Ltd. [NM], Battersea Quarry	Storington Twp.
56. Griffin Brothers Ltd. [NM], Joyceville Quarry	Pittsburg Twp.
57. Griffin Brothers Ltd. [NM], Lynns Quarry	North Crosby Twp.
58. Halton Crushed Stone Ltd. [NM], Limestone Quarry	Milton
59. Hard Rock Paving Co. Ltd., Limestone Quarry	Port Colborne
60. Indusmin [8], Nepheline Syenite Quarry/Processing Plant	Blue Mountain
61. Indusmin [8,NM], Nepheline Syenite Quarry/Processing Plant	Nephton
62. Indusmin [8,NM], Silica Operations	Badgeley Island
63. Karson Kartage & Konstruction Co. Ltd. [NM], West Carlton Sand	West Carlton
64. George Kennedy [NM], Limestone Quarry	West Carlton
65. E.C. King Contracting [9,NM], Limestone Quarry	Sydenham Twp.
66. M.J. Labelle Company Ltd. [NM], Limestone Quarry	Moosonee
67. Markham Sand and Gravel [10,NM], Limestone Quarry	Brechin
68. Markham Sand and Gravel [10,NM], Limestone Quarry	Sophiasburg Twp.
69. H.J. McFarland Construction Co. [11,NM], Limestone Quarry	Clarence Twp.
70. H.J. McFarland Construction Co. [11,NM], Limestone Quarry	Nepean
71. H.J. McFarland Construction Co. [11,NM], Limestone Quarry	Tyendinaga
72. McKendry Quarries Ltd. [NM], Glen Quarry	Kingston
73. McKendry Quarries Ltd. [NM], Westbrook Quarry	Westbrook
74. Milton Limestone, Limestone Quarry	Milton
75. Nelson Aggregate Company [NM], Lincoln Quarry	Beamsville
76. Nelson Aggregate Company, Nelson Quarry	Burlington
77. Nelson Aggregate Company, Uhthoff Quarry	Uhthoff
78. Nelson Granite [NM], Granite Quarry	Vermilion Bay
79. Norfolk Quarries Company [12,NM], Limestone Quarry	Pt. Dover
80. Permanent Concrete (Brockville Quarry) [13,NM], Limestone Quarry	Elizabethtown
81. Permanent Concrete (Cornwall Quarry) [13], Limestone Quarry	Cornwall
82. Permanent Concrete (Hawthorne Quarry) [13,NM], Limestone Quarry	Gloucester
83. Permanent Concrete (Navan Quarry) [13,NM], Limestone Quarry	Gloucester
84. Permanent Concrete (Francon - Orleans Quarry) [13,NM], Limestone Quarry	Ottawa (FRANCON)
85. Permanent Concrete (Selby Quarry) [13,NM], Limestone Quarry	Napanee
86. Permanent Concrete (Violet Road Quarry) [13,NM], Limestone Quarry	Kingston
87. Port Colborne Quarries Ltd. [NM], Limestone Quarry	Port Colborne
88. Seeley & Arnill Aggregates Ltd. [NM], Limestone Quarry	Duntroon
89. Smiths Construction Co. Arnprior Ltd. [NM], Limestone Quarry	Arnprior

(...Continued)

TABLE 1.2 (Continued)

Company - Plant	Location
QUARRIES CATEGORY (Continued)	
90. Spratt Sand & Gravel Ltd. [NM], Limestone Quarry	Stittsville
91. St. Lawrence Cement Inc. [NM], Limestone Quarry	Colborne
92. Standard Aggregates Inc. [NM], Limestone Quarry	Brechin
93. Standard Aggregates Inc. [NM], Limestone Quarry	Gore Bay
94. Standard Aggregates Inc. [NM], Limestone Quarry	Hagersville
95. Steeprock Calcite [NM], Calcite Quarry	Tatlock
96. Steetley Quarry Products Inc. [NM], Limestone Quarry	Flamborough
97. Steetley Quarry Products Inc. [NM], Queenston Quarry	Niagara Falls
98. G. Tackaberry & Sons Construction Co. Ltd. [NM], Limestone Quarry	Elizabethtown Twp.
99. G. Tackaberry & Sons Construction Co. Ltd. [NM], Lowson Quarry	Escott Twp.
100. G. Tackaberry & Sons Construction Co. Ltd. [NM], Willows Quarry	Kitely Twp.
101. G. Tackaberry & Sons Construction Co. Ltd. [NM], Jasper Quarry	Wolford Twp.
102. Taro Aggregates Limited [NM], Limestone Quarry	Stoney Creek
103. 3M Canada Ltd., Traprock Quarry & Processing Plant	Havelock
104. R.W. Tomlinson Ltd., Limestone Quarry	Nepean
105. United Aggregates Ltd. [NM], Limestone Quarry	Acton
106. United Aggregates Ltd. [NM], Limestone Quarry	Gloucester
107. Walker Industries (Ridgemont Quarries Ltd.), Limestone Quarry	Fort Erie
108. Walker Industries [NM], Vineland Quarries & Crushed Stone Ltd.	Vineland
109. Walker Industries [NM], Walker Brothers Quarries Ltd.	Thorold
110. Warren Paving & Materials [NM], Dibblee Construction Ltd.	Cornwall
111. Warren Paving & Materials [NM], Dibblee Construction Ltd.	Kingston
112. Warren Paving & Materials, Dibblee Construction Ltd., Boyce Quarry	Gloucester
113. Warren Paving & Materials [NM], Dibblee Construction Ltd.	Nepean
114. Warren Paving & Materials [NM], Dibblee Construction Ltd.	Montague
115. Warren Paving & Materials [NM], Dibblee Construction Ltd.	Stittsville
116. Waterford Sand & Gravel Ltd. [NM], Limestone Quarry	Stoney Creek
117. Woods's Sand and Gravel Ltd., Limestone Quarry	Kingston
SAND AND GRAVEL CATEGORY (SIC Code 0821)	
118. Frank Kling Ltd., Sand and Gravel Pit	Seaforth
119. Kam Aggregates Limited, Sand and Gravel Pit	Kaministiqua
120. Lempiala Sand & Gravel Ltd., Sand and Gravel Pit	Thunder Bay
121. Oxford Sand and Gravel Ltd., Sand and Gravel Pit	Woodstock
122. Seeley & Arnill Aggregates Ltd., Durham Stone & Paving	Durham
123. Standard Aggregates Inc., Sand and Gravel Pit	Guelph
TALC CATEGORY (SIC Code 0629)	
124. Canada Talc Ltd., Underground Mine	Madoc
125. Luzenac Inc., Open Pit Mine	Timmins

NOTES: Plant numbers correspond to item numbers in the source indicated below.

[1] Wholly-owned susidiary of Dofasco Inc.
[2] A Subsidiary of BeachviLime Limited which is a subsidiary of Dofasco Inc.
[3] Steetley Lime and Aggregates Division
[4] A Division of Jannock Limited
[5] Frontenac Aggregates & ConstructionDivision
[6] Glengarry Aggregates and Concrete Division
[7] A Subsidiary of St. Lawrence Cement
[8] A Division of Falconbridge Limited
[9] A Division of Brennan Paving & Construction Limited
[10] A Division of Miller Paving Limited
[11] A Division of George Wimpey Canada Limited
[12] A component of Trent Valley Sand & Stone Ltd.
[13] A Division of Lafarge Canada Inc.
[NM] A quarry that will not be monitored but will share costs.

Source: Ontario Ministry of the Environment (1989a), Part C - Schedule A.

monitoring regulation. The report will also present estimates of certain costs under an alternative scenario in order to test the cost-effectiveness of the requirements. Cost-effectiveness implications have been among the factors considered in arriving at the agreed-to protocols and requirements (Ontario Ministry of the Environment, 1989a).

This report also presents estimates of the economic and financial effects of the monitoring costs on Ontario's industrial minerals sector, its various subsectors, and where possible, on individual firms. Financial data are not available for many of the specific plants and firms in this sector, and the financial analyses presented in this report reflect this limitation.

A review of the physical and economic dimensions of the industrial minerals sector and its various subsectors is to be developed as a separate profile report (Ontario Ministry of the Environment, 1989b). An abbreviated version of sector profile is presented in Chapter 2 and in Appendix B. Data from the profile report are used in the analyses found in Chapter 4.

1.5 Cost Estimation Methods

Incremental costs of monitoring consist of recurring **operating and maintenance** costs and one time **capital and installation** costs. In this report, capital and operating costs have been estimated for each monitoring function at each plant. All cost estimates are expressed in 1989 dollars.

Steps involved in cost estimation include postulation of the activities, procedures and resource requirements which are required to implement each monitoring function specified in the regulation, subject to simplifying assumptions where necessary.

Single-valued or point estimates of costs are presented but they should be treated with caution. Inputs required for different types of monitoring functions are often uncertain and there is some flexibility as to how individual plants may implement the various monitoring requirements. Estimates of capital costs are invariably subject to contingencies, error and uncertainty.

For the above reasons, ranges of capital and operating costs are presented for some monitoring functions.

Cost-effectiveness of the monitoring requirements has been examined by comparing the costs associated with the proposed monitoring requirements to potential costs that would be incurred under alternative requirements considered during the course of regulation development. Estimates are provided for the additional cost that would be imposed on the sector by requiring all plants in the Quarries category, rather than 20 representative sites, to undertake monitoring activities. The cost impacts of alternative sampling requirements are also assessed.

2.0 PROFILE OF THE INDUSTRIAL MINERALS SECTOR

This chapter presents some background information on the industrial minerals sector. More detailed information on the various industry categories which comprise the sector are provided in Appendix B. The discussion which follows is intended to provide a context for the material in the next two chapters which include estimates of the incremental costs of the Monitoring Regulation and the analyses of their economic and financial consequence.

The industrial minerals sector consists of plants in Ontario involved primarily in the mining and/or processing of non-metallic minerals and structural materials. There are approximately 3,000 industrial mineral plants and mines in the province. Demand for the products of Industrial Mineral Sector is a derived demand, in that products of this sector constitute the raw materials for other industrial sectors. The end-users are generally related to the construction, pulp and paper, and steel industries.

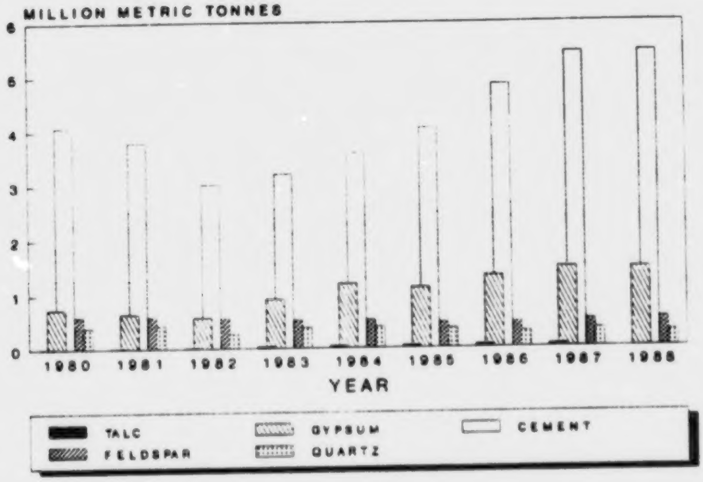
The value of production by those plants which comprise the industrial minerals sector is not known. However, the total value of Ontario production of non-metallic minerals and structural materials was $1.5 billion in 1987, the most recent year for which complete information is available (Ontario Ministry of Northern Development and Mines, 1988). This $1.5 billion total amounts to 0.7% of Ontario's 1987 gross domestic product (GDP) of $225.4 billion. Likewise, the employment at those plants in the sector is not known, but total employment in Ontario plants involved in producing non-metallic minerals and structural materials was about 7,900 in 1987 (Ontario Ministry of Northern Development and Mines, 1989). This figure represents 0.2% of Ontario's total 1987 employment of 4,689,000.

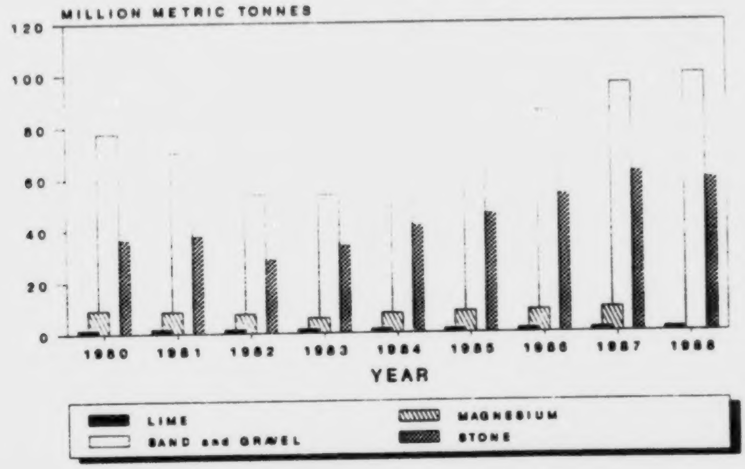
Historical information relating to volumes and values of production are available for many of the products produced in this sector. Figure 2.1 shows the volumes, and Figure 2.2, the values, of production of selected products in the industrial minerals sector during the 1980's.

Nearly all of the Ontario plants in the cement, gypsum and magnesium industries are subject to the MISA Monitoring Regulation. In such cases, the information provided accurately reflects the situation at the corresponding plants in the sector, taken as a group. In other industries, sand and gravel most notably, only

Figure 2.1

Volumes of Production of Selected Industrial Minerals Commodities (1980 - 1988)

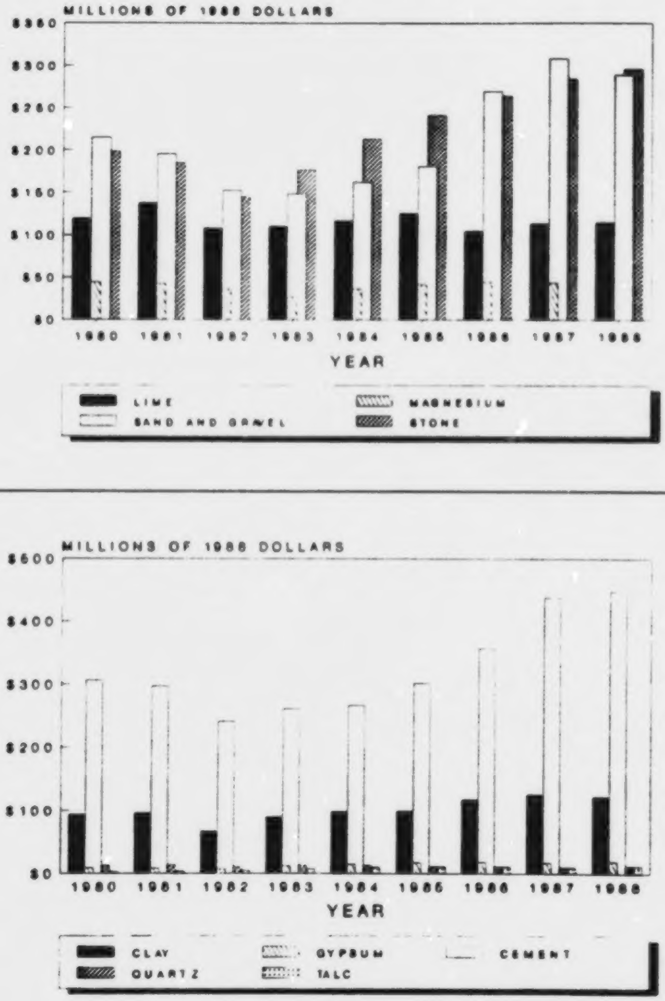




Source: Ontario Ministry of Northern Development and Mines, 1988 and 1989.

Figure 2.2

Values of Production of Selected Industrial Minerals Commodities (1980 - 1988)



Source: Ontario Ministry of Northern Development and Mines, 1988 and 1989.

only a small percentage of the firms are direct dischargers and subject to the Regulation. In such cases, it is assumed that the trends at the plants represented in the sector are accurately reflected in the illustrated total figures. Similarly, unless there is evidence to the contrary, it is assumed that trends for total production of the various products reasonably reflect trends at the individual plants which produce those same products.

Figure 2.1 indicates that, for many industrial minerals commodities, quantities produced each year fell during the recession of the early 1980's. Production then increased each year from 1983, peaking in 1987. Figure 2.2 presents a similar picture for the values of production of many of the commodities. One exception is the value of lime production in constant dollars (i.e., adjusted for inflation) which peaked in 1981 and has been relatively constant since 1982.

Industrial mineral producers range from multi-national corporations with a varied product mix to small single-plant with one product. Seventy-two industrial minerals firms operating a total of 125 plants in Ontario are identified as direct dischargers and are subject to the MISA Monitoring Regulations. Most of the firms in the sector are small and/or privately held.

Financial data are publicly available for only 11 of the 72 firms which operate plants in the sector. These 11 companies operate 29 plants in the six of the nine industry categories; no corporate or plant-level financial information is available for plants in the Graphite, the Sand and Gravel, and the Talc categories. Table 2.1 presents the available financial statistics for these 11 companies, including net earnings (i.e., after-tax profits), capital expenditures, and rates of return (ROR) on capital employed for each year between 1983 and 1988. In some cases, supplementary financial data for parent corporations or relevant operating divisions appear as well.

For two of the companies, Lafarge Canada Inc. and St. Lawrence Cement Inc., net earnings increased each year over the period considered. Brampton Brick Limited, CGC Inc., Domtar Inc., and Jannock Limited (owner of Canada Brick) saw net earnings increasing each year until 1987, only to fall in 1988. Net earnings for Timminco peaked in 1984 and fluctuated during the subsequent years, with a net loss suffered in 1987. Net earnings for the remaining companies initially increased, then fell during the middle years, only to increase again through 1988. Capital expenditures were

TABLE 2.1: SELECTED FINANCIAL STATISTICS FOR PUBLIC CORPORATIONS IN THE INDUSTRIAL MINERALS SECTOR

FIRM	Financial Statistic	1983	1984	1985	1986	1987	1988	Average 1983-1988
Brampton Brick Limited	Net Income	n.a.	$1,032	$1,474	$4,341	$6,319	$3,30[illegible]	$3,295
	Capital Expend.	n.a.	$1,350	$209	$8,998	$22,711	$15,843	$9,822
	ROR on Capital (%)	n.a.	n.a.	n.a.	n.a.	12.65%	5.72%	9.18%
CGC Inc.	Net Income	$4,234	$17,477	$26,906	$42,109	$52,665	$47,064	$37,244
	Capital Expend.	($3,739)	$2,140	$1,810	n.a.	$5,610	$7,424	$4,246
	ROR on Capital (%)	n.a.	19.22%	20.42%	n.a.	64.46%	41.58%	36.42%
Dofasco [1]	Net Income	$120,482	$180,605	$170,094	$135,892	$153,990	$222,000	$152,213
	Capital Expend.	$52,686	$83,879	$171,702	$423,213	$415,584	$248,600	$229,413
	ROR on Capital (%)	9.12%	11.50%	8.93%	7.33%	7.12%	6.97%	8.50%
Domtar Inc.	Net Income	$40,200	$93,900	$110,400	$145,000	$161,000	$83,000	$105,583
	Capital Expend.	$107,700	$132,900	$284,400	$457,100	$511,000	$407,000	$316,683
	ROR on Capital (%)	6.20%	9.48%	8.67%	8.17%	7.13%	4.40%	7.34%
Construction Mat'ls Group	Operating Income	n.a.	$35,000	$53,000	$104,000	$96,000	$17,000	$61,000
	Capital Expend.	n.a.	$17,000	$18,000	$29,000	$30,000	$48,000	$28,400
	ROR on Capital (%)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Falconbridge Ltd. [2]	Net Income	($3,542)	$80,186	$38,543	$70,269	$73,120	$341,103	$99,947
	Capital Expend.	$24,321	$52,683	$43,476	$106,658	$85,702	$104,685	$69,588
	ROR on Capital (%)	3.53%	8.09%	6.42%	4.45%	5.81%	18.96%	7.88%
Indusmin Division	Earnings contribution	$3,533	$4,102	$3,086	$6,749	$5,561	$7,109	$5,023
	Capital Expend.	n.a.	n.a.	$3,485	$4,198	$6,072	$7,000	$5,189
	ROR on Capital (%)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Jannock Ltd. [3]	Net Income	$12,490	$17,864	$27,737	$39,473	$110,636	$48,396	$42,766
	Capital Expend.	$6,474	$9,538	$31,163	$73,299	$42,400	$30,000	$32,146
	ROR on Capital (%)	12.22%	13.02%	17.27%	20.70%	21.88%	15.23%	16.72%
Lafarge Canada Inc. [4]	Net Income	($22,897)	$27,149	$41,450	$60,604	$86,699	$113,036	$51,007
	Capital Expend.	$13,942	$29,537	$29,733	$61,033	$72,827	$91,060	$49,689
	ROR on Capital (%)	-0.08%	5.88%	9.98%	13.05%	16.44%	17.00%	724.00%

...Continued

TABLE 2.1 (Continued)

FIRM	Financial Statistic	1983	1984	1985	1986	1987	1988	Average 1983-1988
Minnesota Mining and Manaufacturing Company	Net Income [*]	$667,000	$733,000	$664,000	$779,000	$918,000	$1,154,000	$819,167
	Capital Expend.	n.a.	$701,000	$768,000	$704,000	$722,000	$841,000	$622,667
	ROR on Capital (%)	n.a.	n.a.	n.a.	n.a.	16.55%	19.07%	17.81%
3M Canada Inc.	Net Income	$25,430	$30,849	$27,822	$27,330	$38,736	$51,737	$33,651
	Capital Expend.	$12,795	$16,770	$16,100	$19,000	$20,600	$21,160	$17,738
	ROR on Capital (%)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
St. Lawrence Cement [5]	Net Income	$4,182	$17,281	$33,556	$45,602	$71,038	$86,602	$43,044
	Capital Expend.	$10,304	$55,677	$104,918	$30,958	$29,302	$77,755	$51,486
	ROR on Capital (%)	9.38%	12.48%	13.05%	14.92%	19.52%	18.88%	14.71%
Stelco Inc.	Net Income	($14,240)	($3,280)	$77,649	$57,593	$63,393	$96,784	$46,317
	Capital Expend.	$41,782	$32,438	$136,253	$273,510	$243,800	$511,000	$206,464
	ROR on Capital (%)	2.03%	4.38%	6.08%	4.95%	5.84%	7.47%	5.13%
Timminco Limited	Net Income	$2,518	$4,522	$3,040	$3,907	($4,057)	$1,905	$1,973
	Capital Expend.	$828	$2,747	$2,706	$2,675	$8,165	$4,654	$3,629
	ROR on Capital (%)	11.43%	16.52%	12.08%	8.82%	6.64%	6.74%	10.37%

NOTES: Net Income and Capital Expenditures are reported in Thousands of Current Dollars; Rate of Return (ROR), in per cent.
n.a. = Not Available.
[*] In U.S. Dollars.
[1] Operates three plants in the Chemical Lime category through its BeachviLime and Guelph DoLime subsidiaries.
[2] Operates three plants in the Quarries category through its Indusmin Division.
[3] Operates four plants in the Clay and Shale category through its subsidiary Canada Brick Company Limited.
[4] Operates two cement plants, and eight plants in the Quarries category through its Francon - Ottawa and Permanent Concrete divisions.
[5] Operates one cement plant and two plants in the Quarries category, one through its subsidiary Dufferin Aggregates.

SOURCE: Corporate Annual Reports and Financial Post Information Service.

marked by a generally increasing trend between 1983 and 1988 for all 11 companies, but were lower in 1988 than in previous year for eight of the 11 firms. No clear pattern emerges for rates of return on capital employed during the period in question, as they generally increased for some companies but decreased for others.

To augment the corporate financial information presented in Table 2.1, selected 1987 financial performance statistics for various industry categories are presented in Table 2.2. These statistics were derived from the Annual Census of Mines, Quarries and Sand Pits. These indicators provide some basis for the analysis of financial impacts for those industry categories for which no corporate information are available. They also provide alternative measures for companies with similar statistics reported for the public corporations.

TABLE 2.2: SELECTED PERFORMANCE STATISTICS FOR THE INDUSTRIAL MINERALS SECTOR: AVERAGE FIGURES FOR 1987 BY COMMODITY (In $1,000's)

Item	Census of Mines Question #	Cement	Lime	Clay	Gypsum	Quartz	Stone	Sand and Gravel [*]	Talc
REVENUES									
a. Adjusted value of shipments of own production (Net Sales)	8.5	$59,920	$15,506	$8,907	$5,516	$10,180	$3,237	$303	$4,816
b. Supplementary revenues (other incomes)	12.1	2	8	1	0	0	3	10	1
c. Payment from other estab. (consignment)	8.6	39	0	0	0	0	3	8	0
d. Selected non-mining outputs	9.7	1,804	450	1,551	0	0	123	64	11
e'. TOTAL REVENUES (Reported)	13.6.5				$5,516	$10,334			$5,334
e". [Estimated: a+b+c+d]		$61,765	$15,963	$10,459	$5,516	$10,180	$3,367	$384	$4,829
EXPENSES									
f. Consumption of purchased fuel and electricity (Energy input)	5.11	$10,413	$4,969	$1,081	$910	$885	$300	$21	$950
g. Total of materials, containers, supplies and cost of work done	6.9	10,911	3,652	1,068	2,363	2,061	672	69	1,680
h. All employees at location (Salaries and wages)	14.1.9	6,757	2,857	1,927	2,488	3,039	592	119	1,793
i. Interest expenses and bank charges									
j. Total expense before write offs & taxes	13.6.12				5,084	8,128			
k. Depreciation	13.6.16				126	175			
l. Write offs	13.6.13 + 13.6.14				116	59			381
m. TOTAL OPERATING COSTS [(j or f+g+h+i) + k + l]		$28,081	$11,478	$4,076	$6,003	$8,361	$1,564	$209	$4,804
n. EARNINGS FROM OPERATIONS [Estimate: (e' or e") - m]		$33,684	$4,486	$6,383	($488)	$1,973	$1,803	$175	$24
o. - Taxes	13.6.17				10	143			48
p. + Extraordinary items									
q. TOTAL EXPENSES (Reported)	13.6.18				$5,211	$8,329			$5,099
r. AFTER-TAX PROFITS [Estimate: e' - q]					$305	$2,005			$234
OTHER PERFORMANCE MEASURES									
s. Capital Expenditures	13.8.1 + 13.8.2				$269	$479			$185

NOTE: Question Numbers apply to the questionnaire for Stone (S.I.C. 083/S.I.C. 081) and may differ slightly from those for other minerals. The number of plants responding in each category is excluded to maintain confidentiality.

[*] Includes small plants that would not be subject to the Regulation.

SOURCE: Ontario Ministry of Northern Development and Mines, from the Annual Census of Mines, Quarries and Sand Pits, 1987.

3.0 MONITORING REQUIREMENTS AND COST ESTIMATES

3.1 Monitoring Functions

The ("General" and "Ontario Mineral Industry: Group "B") Effluent Monitoring Regulations specify requirements for six major monitoring activities which each wastewater discharger must implement to various degrees and levels of effort.

1. Sampling
2. Characterization analyses
3. Routine analyses
4. Toxicity testing
5. Flow measurement
6. Reporting

In addition, the General Regulation specifies sampling, analytical and reporting protocols which must be followed by all industrial sectors unless overridden by the sector-specific regulation. In particular, these protocols dictate procedures for taking sampling, storing them and preparing them for analysis, as well as the analytical techniques required for each type of test and the format in which results are to be reported.

Nine types of effluent streams or "sampling points" are defined in the regulation:

1. Cement plant effluent
2. Lime plant effluent
3. Graphite plant effluent
4. Gypsum plant effluent
5. Magnesium plant effluent
6. Minewater effluent
7. Quarry water effluent
8. Storm water
9. Wash water effluent

Only one of these sampling points, storm water, is defined in the General Regulation and so is subject to the provisions of that Regulation. The remainder of the sampling points are defined for this sector by the Sector Monitoring Regulation.

Because there are a large number of quarries in the sector and the characteristics of their effluents, are similar, the Sector Monitoring Regulation recognizes that statistically reliable information on effluents can be obtained without monitoring all sites. It was therefore decided that monitoring would not be required at all sites in the Quarries category. This approach was taken so as to reduce the cost burdens on the plants in this category, to the extent that it was judged possible to do so without a significant loss of information about the effluents from the quarries.

A representative sampling of 20 quarries has been selected for monitoring based on geology, size of the operation, geographical distribution, and wastewater quality. The remaining 74 quarries are designated in the Regulation as "non-monitoring sites". The incremental costs of monitoring are to be shared by all 94 quarries which are subject to the Regulation.

Consequently, 51 of the 125 plants in the sector will monitor their effluent streams while the remainder are non-monitoring sites. At this writing it is believed that the 51 plants have a total of 62 sampling points. The number of sampling points is subject to change as plants combine effluent streams or as information is updated. The distribution of sampling points by industry category is shown in Table 3.1

The MISA monitoring requirements for the industrial minerals sector provide for different testing schedules according to the type of effluent stream at each plant. For the most part, the different plants within each industry category must test like sampling points for the same compounds and at the same frequency. One lime plant and one quarry must carry out additional tests as compared to other plants in their categories as a consequence of information obtained from pre-regulation monitoring.

MISA monitoring requirements differ by sector. Some sectors have had plant- and pipe-specific schedules while other sectors have had uniform requirements for all plants or at least for like effluent streams at each plant. The latter approach was adopted for the industrial minerals sector in that like effluent streams within each industry category face uniform requirements.

TABLE 3.1: SAMPLING POINTS BY INDUSTRY CATEGORY

Industry Category	Number of Plants	Sampling Points									
		Total	C	L	Gr	Gy	Mg	M	Q	S	W
(a) Cement	6	11	6						5		
(b) Chemical Lime	6	6		6							
(c) Clay and Shale	5	5								5	
(d) Graphite	2	4			2				1	1	
(e) Gypsum	3	5				2		3			
(f) Magnesium	1	2					1			1	
(g) Quarries	20/94*	21							16		5
(h) Sand and Gravel	6	6									6
(i) Talc	2	2						1	1		

NOTES:

C = Cement plant effluent sampling points
Gr = Graphite plant effluent sampling points
Gy = Gypsum plant effluent sampling points
L = Lime plant effluent sampling points
Mg = Magnesium plant effluent sampling points
M = Minewater effluent sampling points
Q = Quarry water effluent sampling points
S = Storm water sampling points
W = Wash water effluent sampling points

* = A representative sample of 20 quarries will be monitored, but the costs will be shared by all 94 quarries which are subject to the regulation.

SOURCE: Ontario Ministry of the Environment (1989a) and information from the MISA Office.

3.2 Sampling

Sampling protocols and specifications are defined in Section 3 of the "Effluent Monitoring - General" Regulation.

This function involves taking water samples from designated sampling points under prescribed procedures and conditions, storing samples under refrigeration where necessary and transporting samples to lab facilities within a prescribed time period. Samples must be taken to perform characterization and routine analyses and biological toxicity tests.

Samples may be taken by hand under the prescribed frequency or by means of automatic sampling equipment. By whatever means they are collected, samples must then be taken to a facility for preparation and, if necessary, for refrigerated storage.

Operating costs for sampling are based on estimates of effort for this and other monitoring activities which are summarized in Table 3.2. Only estimates for the Quarries and the Sand and Gravel industry categories have been provided by industry representatives (R.A. Knapp, 1989). In the absence of information specific to other industry categories, it will be assumed that plants in the other categories are subject to the same labour requirements and costs as plants in the Quarries and the Sand and Gravel categories.

Assuming that grab samples are taken by hand, industry representatives estimate that sample collection for routine analyses will require six labour hours for each three-grab composite sample or two labour hours for each grab sample. These estimates allow for sample preparation and paperwork. The actual time required for taking three grab samples, sample preparation and paperwork would be considerably less than six hours, but it is asserted by industry sources that the time between samples would not be spent productively on other work-related activities. Because of the slack time between grabs, it will be assumed that any plant with more than one effluent sampling point will require only two additional hours for sample collection for routine analyses for each additional effluent sampling point.

With a few exceptions discussed below, plants in the industrial minerals sector will be required to

TABLE 3.2

ESTIMATE OF SELECTED OPERATING AND MAINTENANCE COSTS FOR THE QUARRIES AND THE SAND AND GRAVEL CATEGORIES

TASK	ANNUAL COSTS (DOLLARS PER PLANT)		
	W	All	3/W
Sampling			
1. Sample collection labour			
a. Routine analysis:			
- with settling pond (single grab sample: 2 hrs x 52 wks = 104 hrs/yr @ $15/hr)	$1,542*		
- without settling pond (3-grab composite sample: 6 hrs x 3 x 52 wks = 936 hrs/yr @ $15/hr)			$14,040
b. Characterization analysis and toxicity testing:			
- allow 1 day consultant expenses for each sample:		$500	
2. Miscellaneous expenses:			
- bottles, courier, shipping cartons, etc...	2,496*	or	6,240
Flow Measurement			
3. a. calibration		1,000	
b. labour for recording (1/2 hr per sampling day @ $15/hr)	390*		1,170*
Reporting			
4. Routine data submission for MISA site report/site plans		2,500	
TOTAL (for plants with a settling pond)	$8,428		
(for plants without a settling pond)			$25,450

Notes: "W" refers to plants which are allowed to sample once per week; "All" refers to all plants in the Quarries and the Sand and Gravel categories; "3/W" refers to plants which must sample three times per week;

* Indicates that adjustments have been made to estimates provided by the source noted below so as to account for less frequent sampling when a settling pond is used: for (1-a), as indicated; for (2), 40% of cost shown for weekly sampling; for (3-b), one or three times per week rather than daily.

Source: Knapp, R.A. (April 26, 1989), Memorandum to K. Donyina, MISA Industrial Section, on behalf of the Aggregate Producers Association of Ontario.

collect a three-grab composite sample three times per week during the year. Samples for tests to be carried out less frequently can be collected concurrently with those required thrice weekly, so that additional time would not be required. In the Quarries and the Sand and Gravel categories, plants that have settling ponds are allowed to conduct one-grab sampling for routine analyses and test on a weekly basis those parameters that would otherwise have to be tested thrice weekly. For the purpose of the Monitoring Regulation, a settling pond must have a retention time of at least 24 hours in order that the plant qualify for less frequent testing. In the remaining industry categories, only grab-composite or automatically collected composite samples are permitted. One-grab sampling is permitted for all storm water sampling points.

Industry representatives suggest that a wage rate of $15 per hour should be allowed for labour costs in the Quarries and the Sand and Gravel categories (R.A. Knapp, 1989). In the absence of further information, this same wage rate will be used to estimate costs related to labour requirements in the remaining industry categories. In the Quarries and the Sand and Gravel categories, each plant with a single effluent stream and a settling pond is expected to incur up to $1,560 in labour costs for sample collection for routine analyses over the 12-month monitoring period (i.e., two hours each week for 52 weeks at $15/hour). In the other industry categories, each plants with a single effluent sampling point is expected to incur labour costs for the year of up to $14,040 for this purpose (i.e., six hours, three times each week for 52 weeks at $15/hour). Each additional effluent sampling point is expected to add $4,680 for the year (i.e., two hours, three times each week for 52 weeks at $15/hour). Each storm water sampling point is expected to add $360 in labour costs over a year for sample collection for routine analysis (i.e., two hours, twelve times during the year at $15/hour).

Most plants in the sector are expected to take grab samples by hand. However, automatic composite samplers are available for about $5,000 plus the cost of the installation. Automatic composite samplers installed outdoors must contain a refrigerated sample holder in an insulated housing to protect from freezing. The cost of these units is usually included in the capital and installation costs of the automatic samplers. No plant in the industrial minerals sector to date has indicated its intent to install and use an automatic sampling device.

Labour costs of $14,040 per year per plant for sample collection for routine analyses seem high when compared to the estimated cost of an automatic sampling device of $5,000 plus installation. However, time would still have to be allowed for collecting the sample from the sampling device, preparing it for shipment, for paperwork and for equipment maintenance. The total capital and operating and maintenance cost of sample collection when an automatic sampling device is used may be close to the total labour cost when sampling is done by hand.

The decision as to whether to employ an automatic sampler may depend on whether a plant feels that such a device will be useful for any monitoring that may be required after the twelve-month period of the Sector Monitoring Regulation. Financing, tax considerations, labour relations and other factors that can influence a firm's decision as to whether to incur labour costs or capital costs may also affect the choice of sampling procedures and equipment to be employed.

In addition to the cost estimates of sample collection for routine analyses, estimates are required for the costs of sample collection for characterization and toxicity testing. With one exception, plants in the Quarries and the Sand and Gravel categories must collect a sample for characterization analyses once during the year and a sample for toxicity testing once during the first six months after the Regulation comes into force. All plants in the other industry categories, along with the Traprock Quarry owned by 3M Canada Inc., must collect samples for characterization analyses semi-annually and samples for toxicity testing once during each of the first two quarters after the Regulation comes into force.

According to the Regulation, plants must "make every reasonable effort" to collect samples for toxicity testing on the same day as samples for characterization analyses (Ontario Ministry of the Environment, 1989a. Part C, Subsection 12(8)). It is assumed that samples required for characterization analyses and for toxicity testing will be collected on a single day for each plant in the Quarries and the Sand and Gravel categories. It is assumed that three separate days of sample collection for these purposes will be required for plants in the other industry categories--joint sample collection on one day; one day for collection of the sample for the second toxicity test during the first two quarters; one day for sample collection for the second instance of semi-annual characterization analyses.

Industry representatives have suggested that sample collection for characterization analyses and toxicity testing could be carried out by a consultant at a cost of $500 per day. Consequently, the cost of sample collection for these purposes is estimated to be $500 per plant for most plants in the Quarries and the Sand and Gravel categories. The cost for all plants in the other industry categories and for the 3M quarry is estimated to be $1,500 per plant.

The potential exists for higher sampling costs, since additional toxicity testing will be required for any plant for which there is failure of one or more of the initial toxicity tests. Three additional samples would have to be collected, at an estimated cost of $1,500, for plants in the Quarries and the Sand and Gravel categories. A further cost, estimated at $2,500 per plant, would result for plants in the other industry categories. Such plants would have to collect six additional samples, but one could be collected on the same day as the second sample for characterization analyses.

It is assumed for the purpose of predicting the total incremental costs of the Monitoring Regulations that the minimum number of toxicity tests will be carried out at each plant. As noted in the "Technical Rationale for the Monitoring Requirements" (Ontario Ministry of the Environment, 1989a. Part B, Section XVI), the frequencies were determined based on the assumption that effluents from this sector are expected to be non-lethal. Effluents from this sector are not contaminated wastewater like effluents in other MISA sectors. To the extent that any plants do experience a failure of one or more of the initial toxicity tests, the actual incremental costs of sampling are likely to be higher than the estimated costs presented in this report.

It is not anticipated that any plants in the industrial minerals sector will require an additional vehicle for the collection of samples within the plant. The total required volume for each set of samples for routine analyses is less than two litres. A set of samples for characterization analyses requires approximately five litres while each toxicity test requires a sample of at least 80 litres. Samples for characterization and toxicity testing are to be collected only once or twice during the year, depending on the subsector. However, additional toxicity tests will be required of any effluent stream which fails an initial toxicity test. The minimum sample volume required for each test is specified in the General Regulation.

A plant might require the acquisition of a vehicle for the sample collection within the plant, particularly if its existing stock of vehicles is used to capacity. A new van costs about $18,000 to buy or $6,000 per year to lease. Assuming that a vehicle is driven 4,000 kilometres during the year for the purpose of sample collection, an additional cost of $1,200 would accrue based on the Ontario government rate of $.295/km. Assuming that a van is leased and that it travels 4,000 kilometres, the incremental cost of a vehicle for sample collection would be $7,200 in operating costs for the year. At this writing, no plant is expected to require the acquisition of a vehicle for sample collection.

In the event that a vehicle is required for collection of the higher sample volume required for toxicity testing, short term rental, rather than purchasing or leasing, would provide a better indication of incremental costs related to the Regulations.

The Regulations further require that samples be stored at a temperature no higher than 10°C and that they must be prevented from freezing. Therefore, each plant will require refrigeration equipment to store samples while they are awaiting transport to a commercial laboratory. The quantities requiring refrigerated storage total less than 10 litres except on the one or two days during the year when samples must be collected for toxicity testing.

It is assumed that each plant will provide a portable cooler for the storage of the samples for routine analysis, at an estimated cost of $100 per plant. The total estimated cost of coolers for the sector amounts to $5,100 for the 51 plants that will carry out monitoring activities. The estimated cost of coolers is included with operating and maintenance costs. It is assumed that the cost of refrigeration for the larger volume samples required for toxicity testing and characterization analyses is included in the sampling costs of $500 per day allowed for these tests.

Once samples are collected and prepared, they will have to be taken directly to a laboratory or to a site from which they can be transported to a laboratory. It will be assumed for the purpose of this analysis that all tests are carried out by commercial laboratories.

An estimate of the cost required to transport samples from plants to commercial laboratories is also provided in Table 3.2. For a plant with a single sampling point and thrice weekly monitoring, the cost of sample bottles, shipping cartons, courier charges and other miscellaneous transport expenses is expected to total $6,240 for the year (R.A. Knapp, 1989). Although this estimate was provided by industry representatives for plants in the Quarries and the Sand and Gravel categories, it is assumed to apply to plants in other categories, as well. However, it is assumed that only 40% of the above estimate, or $2,496 per plant, will be required for plants in the Quarries and the Sand and Gravel categories which are allowed to sample on a weekly basis rather than three times per week.

Other adjustments to the estimate of transport expenses are made for plants which must sample on a monthly basis and for those with more than one sampling point. It is assumed that $624 per plant, which amounts to 10% of the initial estimate, applies to plants which have storm water sampling points. Such sampling points will be tested on a monthly basis. In addition, it is assumed that transport costs for a second sampling point of any type will add a further 50% of the amount required for a single sampling point of that type.

In the event that plants expect to transport samples from the plant to a laboratory with vehicles that they own or lease, an allowance will be made for the additional kilometres driven for this purpose.

Estimates of operating and maintenance costs of sampling for the year are reported by plant in Table A.1 in Appendix A. These cost estimates are summarized by industry category in Table 3.3. At this writing, there is no indication of any intended capital expenditures for sampling by any plant in the sector.

Based on the assumptions and estimates described above, the cost of sampling for routine monitoring is expected to total $620,700 for the sector. The collection and preparation of samples accounts for $387,800, while the transport of samples to commercial laboratories is expected to add $227,800. The cost of sampling for characterization analyses and toxicity testing is expected to total $51,500 for the sector. Total operating and maintenance costs of sampling are expected to be $672,200 for the industrial minerals sector for the year. However, if toxicity tests should fail for plants in the sector, additional sampling costs could add up to $101,000 to this total.

3.3 Analytical Testing

Analytical testing, which consists of characterization, routine analyses, and toxicity testing, represents the largest component of the incremental operating costs associated with monitoring. Together, the three analytical activities account for $880,300 or 49.4% of the total operating cost of monitoring for the sector. Estimates of the costs of analytical testing activities for the year are summarized by industry category in Table 3.4. The determination of costs for various analytical activities is discussed in greater detail in the following sections.

As noted earlier, it is assumed that characterization, routine analyses, and toxicity testing will be performed by a commercial laboratory, even though some plants may have the ability to conduct many of the analyses on site. This assumption has been made in order to obtain cost estimates that are comparable among plants and among industries.

TABLE 3.3

ANNUAL OPERATING AND MAINTENANCE COSTS OF SAMPLING (IN $1,000's)

INDUSTRY CATEGORY	Routine Analyses			Characterization/Toxicity		TOTAL [*]
	Collect/Prep	Coolers	Transport	Min.	Max.	
CEMENT CATEGORY	$107.6	$0.6	$53.0	$9.0	$24.0	$170.3
CHEMICAL LIME CATEGORY	$84.2	$0.6	$37.4	$9.0	$24.0	$131.3
CLAY AND SHALE CATEGORY	$1.8	$0.5	$3.1	$7.5	$20.0	$12.9
GRAPHITE CATEGORY	$33.1	$0.2	$16.2	$3.0	$8.0	$52.5
GYPSUM CATEGORY	$51.5	$0.3	$25.0	$4.5	$12.0	$81.2
MAGNESIUM CATEGORY	$14.4	$0.1	$6.9	$1.5	$4.0	$22.9
QUARRIES CATEGORY	$57.7	$2.0	$58.7	$11.0	$40.5	$129.4
SAND AND GRAVEL CATEGORY	$9.4	$0.6	$15.0	$3.0	$12.0	$27.9
TALC CATEGORY	$28.1	$0.2	$12.5	$3.0	$8.0	$43.8
SECTOR TOTALS:	$387.8	$5.1	$227.8	$51.5	$152.5	$672.2

NOTE: "Collect/Prep" refers to the labour costs involved with the collection and preparation of samples for testing. "Coolers" refers to the costs of portable coolers for refrigerated storage. "Transport" includes the costs of sample containers, packing materials and courier fees. See the accompanying text for discussion of the procedures used for the determination of sampling costs and Table A.1 for costs by plant.

[*] It is assumed that minimum costs for characterization and toxicity sampling will apply.

SOURCE: Tables 2.2 and A.1.

TABLE 3.4

ANNUAL OPERATING COSTS OF ANALYTICAL TESTING (IN $1,000's)

INDUSTRY CATEGORY	Routine Analyses				Character-ization Analyses	Toxicity Tests	TOTAL ANALYTICAL COSTS [*]
	3/Week	Weekly	Monthly	TOTAL			
CEMENT CATEGORY	$103.2	n.a.	$17.3	$120.5	$71.2	$13.2	$204.8
CHEMICAL LIME CATEGORY	$58.2	n.a.	$10.2	$68.4	$40.9	$7.2	$116.5
CLAY AND SHALE CATEGORY	n.a.	n.a.	$10.9	$10.9	$34.5	$6.0	$51.4
GRAPHITE CATEGORY	$28.4	n.a.	$13.2	$41.6	$19.4	$3.6	$64.6
GYPSUM CATEGORY	$47.1	n.a.	$4.3	$51.4	$33.0	$6.0	$90.4
MAGNESIUM CATEGORY	$9.7	n.a.	$3.0	$12.7	$6.9	$1.2	$20.8
QUARRIES CATEGORY	$29.1	$66.5	$24.0	$119.5	$101.5	$13.2	$234.3
SAND AND GRAVEL CATEGORY	n.a.	$22.2	$4.1	$26.3	$27.0	$3.6	$56.9
TALC CATEGORY	$19.4	n.a.	$4.9	$24.2	$14.0	$2.4	$40.6
SECTOR TOTALS:	$295.0	$88.6	$91.9	$475.6	$348.3	$56.4	$880.3

NOTE: The use of "n.a." indicates that the corresponding testing frequency does not apply to plants in that industry category. See Sections 2.5, 2.6 and 2.7 for discussion of the procedures used for the determination of costs, and Tables A.2 and A.3 for costs by plant.

[*] It is assumed that minimum costs will apply for toxicity testing.

SOURCE: Tables A.2 and A.3

Costs of chemical analyses for the 12-month period of the regulations are based on the mean commercial laboratory test prices that are listed in Table 3.5. This table is derived from a survey of laboratories in Ontario, Quebec and the U.S., although the prices represent only Ontario and Quebec laboratories (M.M. Dillon, 1988). The 27 test groups listed contain about 150 individual chemicals. However, effluent samples from plants in the Industrial Minerals Sector will not be tested for all of the chemicals. Four other tests listed at the bottom of this Table are added specifically for the Sector.

Prices of the tests are assumed to include laboratory quality assurance/quality control (QA/QC) procedures and the preparation of required reports. However, to these prices must be added the cost of field QA/QC which consists of the duplicate tests and travelling blank and spiked samples required by the Regulations.

The listed prices may overstate the true costs of analyses because volume discounts may apply. In addition, the price of testing a single chemical which is part of a larger Analytical Test Group may be less than the price for the entire group which was used in these estimates. Finally, plants may incur a lower cost for some tests if they carry them out themselves. However, prices have likely risen since the price information was gathered in 1987.

3.4 Characterization and Open Characterization Analyses

Characterization is the analysis of a sample by procedures specified in the General Regulation and which is intended to identify and quantify the particular chemical species in analytical test groups 1 to 27 that are specified in the Industrial Minerals Sector Monitoring Regulation. Additional procedures which are intended to identify the presence of contaminants which are not on the sector list are termed open characterization. Gas chromatography/mass spectrometry is used to identify volatile and extractable organic compounds in ATG 28, while ICP (inductively coupled plasma) emission spectroscopy methods are used to identify inorganic contaminants in ATG 29.

TABLE 3.5

LABORATORY TEST PRICES FOR ANALYTICAL TEST GROUPS

No.	Analytical Test Group	Price ($)			
		Low	Median	Average	High
1.	Chemical Oxygen Demand	14.00	26.00	29.78	70.00
2.	Cyanide	10.00	32.50	36.10	100.00
3.	Hydrogen Ion (pH)	1.30	5.75	6.84	30.00
4a.	Ammonia and Ammonium Nitrogen plus Total Kjeldahl Nitrogen.				
4b.	Nitrate and Nitrite	40.00	55.60	86.99	230.00
5.	Organic Carbon (DOC)	10.00	50.00	57.03	130.00
6.	Total Phosphorus	8.75	20.00	25.12	120.00
7.	Conductivity	2.50	8.00	9.44	45.50
8.	Total Suspended Solids (TSS) Volatile Suspended Solids (VSS)	5.00	13.00	14.87	45.50
9.	Metals (13 metals)	10.00	-	84.10	491.40
10.	Hydrides (Arsenic only)	7.00	20.00	23.33	80.00
11.	Chromium (Hexavalent)	5.00	19.00	20.47	53.30
12.	Mercury	7.00	25.75	25.77	85.00
13.	Total Alkyl Lead	39.00	93.75	172.00	420.00
14.	Phenolics (4AAP)	19.50	35.00	42.93	130.00
15.	Sulphide	-	-	30.00	-
16.	Volatiles, Halogenated	83.00	226.25	239.90	1,020.50
17.	Volatiles, Non-Halogenated	85.00	200.00	176.81	435.50
18.	Volatiles, Water Soluble	50.00	195.00	126.50	325.00

TABLE 3.5 (Continued)

LABORATORY TEST PRICES FOR ANALYTICAL TEST GROUPS

No.	Analytical Test Group	Price ($)			
		Low	Median	Average	High
19	Extractables, Base Neutral	100.00	355.00	427.49	1,560.00
20.	Extractables, Acid (Phenolics)	65.00	260.00	245.68	780.00
21.	Extractables, Phenoxy Acid Herbicides	85.00	185.00	188.09	360.00
22.	Extractables, Organochlorine Pesticides	100.00	205.00	270.14	975.00
23.	Extractables, Neutral Chlorinated	105.00	200.00	232.04	900.00
24.	PCDDs & PCDFs	325.00	1,000.00	1,228.27	2,600.00
25.	Oil & Grease	15.00	30.00	36.00	125.00
26.	Fatty Acids & Resins	15.00	143.75	133.18	350.00
27.	PCBs (Total)	40.00	105.00	103.90	240.00
	Open Characterizations				
28.	Volatile and Extractable Organic Compounds	-	-	550.00	-
29.	Elemental	-	-	300.00	-
	Supplemental Test Groups for the Industrial Minerals Sector:				
	IM1 Chloride	-	-	24.90	-
	IM2 Fibrous Chrysotile		Unavailable		
	IM3 Fluoride	-	-	26.50	-
	IM4 Sulphate	-	-	25.80	-

Source: Derived from data in M.M. Dillon (1988), and subsequent telephone survey results reported by Laboratory Services Branch staff.

Characterization and open characterization analyses must be carried out once during the year for each effluent stream sampling point for plants in the Quarries and the Sand and Gravel categories. For plants in the other categories, these analyses are required twice during the year for each effluent stream sampling point and for each storm water sampling point in the Clay and Shale category. Section 6 of the sector Regulation specifies the requirements for characterization and open characterization analyses.

Estimates of the total incremental cost of characterization and open characterization analyses are provided in Table A.2 in Appendix A for each plant and category. As noted in Table 3.4, the cost of this activity to the Industrial Minerals Sector is expected to total $348,300 for the year.

Except at plants which use kilns for the incineration of garbage or solvents, the Industrial Minerals Sector Monitoring Regulation calls for only one analysis of ATG 24 (dioxins and furans) during the life of the regulation. The Regulation also provides that plants which tested for ATG 24 during pre-regulation monitoring need not repeat this test. It is assumed that, for the purpose of this analysis, the $1,228 cost of this test is an incremental cost of the Regulations for all plants in the sector. For those plants which have already carried out this test, the incremental cost estimates would be overstated.

The regulation provides that characterization analysis be carried out for ATG 27 (PCBs) only by those plants that use or store PCBs or by plants at which kilns are used for incineration of garbage or solvents. Information about the use or storage of PCBs must be provided in the initial report but is not currently available. Consequently, it is assumed for the purpose of providing conservative (i.e., high) estimates of incremental costs that all firms in the sector carry out this test at the prescribed frequency.

The cost estimates do not include costs incurred for pre-regulation characterization analyses, with the exception of costs that may have been incurred by some plants for ATG 24, as discussed above. Pre-regulation monitoring is not specifically required by the Regulations even though this work was carried out in anticipation of the MISA monitoring activities. Although pre-regulation costs will not be included among the incremental costs of the Regulations, they will be summarized below along with other costs to be incurred by the sector that are not directly attributable to the Regulations. Consideration of such costs may indicate that a firm or the sector will be more severely affected by the Monitoring costs than would otherwise appear.

3.5 Routine Analyses

Routine analyses involve testing of samples taken at three frequencies specified in the sector regulation - thrice weekly, weekly and monthly. Section 8 of the Regulation provides that those plants in the Quarries and the Sand and Gravel categories which have a settling pond may test on a weekly basis for those parameters which would otherwise have to be tested thrice weekly. All other plants undertake routine analyses of effluent sampling points on a thrice weekly basis, as specified in Section 7 of the Regulation. All plants in the sector must also test for some chemicals on a monthly basis, as specified in Section 9 of the Regulation.

Section 10 of the sector-specific Regulation requires that storm water effluent be analyzed at least once in each month in which there is a "storm event". To make up for months in which there was insufficient flow to collect a sample, plants in the Clay and Shale category are to collect a second sample from storm water sampling points during months in which there is sufficient flow.

It is believed that most effluent sampling points in the Quarries and the Sand and Gravel categories will qualify for weekly rather than thrice weekly testing. As noted above, a pond must have a retention time of at least 24 hours to qualify for less frequent testing. Plants in these categories must provide information about the retention time in their initial reports. This information will not be available until after the Regulation comes into force. Based on current but incomplete information, it is assumed that only two of the 21 sampling points in the Quarries category lack settling ponds (wash water effluent at 3M Canada and quarry water effluent at Wood's Sand and Gravel).

Assumptions must also be made about other provisions of the sector regulation which link the frequency of testing and resulting costs to information to be provided in the initial report. Plants in the Chemical Lime subsector must test for ammonia plus ammonium (ATG 4a) on a monthly basis if explosives are used on site, but semi-annual characterization analyses are sufficient for those plants which use no explosives. For all plants in the sector, analysis for chromium (hexavalent) (ATG 11) is required only if the total chromium concentration exceeds 1.0 milligram/litre. It is assumed for the purpose of cost estimation that plants are subject to the more stringent requirements in such instances.

The annual costs of routine analyses range from $2,200 to $24,700 per plant for the sector. Average cost per plant is lowest for the Clay and Shale, the Quarries and the Sand and Gravel categories. For most plants in these categories, less frequent routine monitoring is anticipated for each effluent stream, and only one sampling point is likely to be tested.

Plants in the remaining categories face higher costs per effluent sampling point. In addition, nine of the 12 plants in the Cement, the Graphite, the Gypsum and the Magnesium categories have two effluent sampling points, so that the average number of sampling points is higher for these subsectors than for the others. For comparison, only one of the plants in the Quarries category and none in the remaining categories have two effluent sampling points. Estimates of the cost of routine analyses by plant and by category are also presented in Table A.2 in Appendix A.

3.6 Toxicity Testing

Biological toxicity testing involves the use of a static 96-hour rainbow trout LC50 mortality test and a 48-hour Daphnia magna (a small invertebrate crustacean) acute lethality test. General procedures for toxicity testing are specified in Section 5 of the General Regulation.

Section 12 of the Industrial Minerals Sector Regulation specifies the number and frequency of toxicity test by subsector and effluent sampling point. Plants in the Quarries and the Sand and Gravel categories are required to carry out toxicity testing once during the first two quarters after the Regulation comes into force for each quarry water and wash water effluent sampling point. Plants in the remaining subsectors are required to carry out toxicity testing once during each of the first two quarters for each effluent sampling points. In addition, plants in the Clay and Shale subsector are required to carry out toxicity testing once during each of the first two quarters from a storm water sampling point.

All plants in the sector are subject to the further requirement that additional toxicity tests be carried out for any effluent stream which fails an initial toxicity test. Three additional tests must be carried out by plants in the Quarries, and Sand and Gravel subsectors if they fail the initial test. Plants in the other subsectors must carry out six additional toxicity tests.

As noted in the "Technical Rationale for the Monitoring Requirements" (Ontario Ministry of the Environment, Part B, 1989a), the frequencies were determined based on the assumption that effluents from this sector are expected to be non-lethal. Effluents from this sector are not likely to be contaminated with additives or residuals as are effluents from other industrial sectors. The sector toxicity testing requirements should provide considerable evidence to help resolve the question of effluent lethality or non-lethality.

Table A.3 in Appendix A lists the minimum and maximum number of biotoxicity tests that could be required annually at each plant and provides estimates of the corresponding costs. Estimates of toxicity testing costs are based on the following prices for a full dilution series:

Trout:	$360 per test
Daphnia:	$240 per test
	$600 per test

Using these prices and the minimum testing schedule for each sampling point, the total cost of this function during the 12-month period amounts to $56,400. If the maximum number of toxicity tests were carried out for all plants, the total annual cost for both types of toxicity tests would be $223,800, a difference of $167,400.

Collection and transport costs for toxicity test samples are discussed, and cost estimates are provided, in Section 3.2.

3.7 Flow Measurement

Flow measurement is required to calculate total loadings of contaminants discharged to the environment in any given time period. Section 13 of the industrial minerals sector Monitoring Regulation specifies the requirements for flow measurement. It provides that the measurement or estimation of flows at sampling points shall be capable of accuracy to within ± 20% of actual flow and that flows shall be measured or estimated at the time of each sampling.

Effluent flows may be measured in a variety of ways ranging from estimates based on the operating time of pumps to calibrated concrete flumes with automated, continuous measurement and recording devices. These systems range in accuracy from about ± 20%, at relatively low cost, to accuracy of up to ± 2%, at higher costs. Recording devices permit continuous measurements instead of infrequent observations.

One system that is widely used and relatively accurate is a calibrated flume. Recording devices can be added to this type of flume, or recordings can be made by staff who visit the site periodically. Less accurate flow measurement systems often involve a lower capital outlay with relatively high ongoing operating expenses. More accurate systems with continuous recording involve substantially higher capital expenditures with somewhat lower operating costs. As indicated above, accuracy of only ± 20% is required for all flow measurements within this sector.

Estimates of operating and maintenance costs related to flow measurement were provided for all plants in the chemical lime category (Ontario Lime Producers Association, undated memorandum). Estimates of operating and maintenance costs for plants in the remaining categories are based on estimates provided for the Quarries and the Sand and Gravel categories and reported in Table 3.2. These cost estimates include $1,000 per sampling point for calibration plus $7.50 per day (i.e., ½ hour @ $15/hour) for each day in which sampling is carried out. The cost per plant ranges from $1,090 in the Clay and Shale category to $4,340 for those plants with two sampling points requiring sampling three times per week.

Estimates of the additional costs to the sector arising from flow measurement are reported by plant in Table A.4 in Appendix A. These costs are summarized by industry category in Table 3.6. The only intended capital expenditures reported to date involve two plants in the chemical lime category and total $10,000. Estimates of the incremental operating and maintenance costs for the year amount to $153,800 for the sector.

3.8 Reporting

Monitoring data will have to be assembled, recorded, stored, and reported to company management and to the Ministry of the Environment.

Furthermore, a detailed "Initial Report" must be prepared and submitted to the Ministry during the period of the Regulation. This report details the plant layout, flow charts of waste streams, analytical methods used and other data, including information discussed in Sections 3.4 and 3.5 above.

Data storage and manipulation will require an AT compatible personal computer together with peripherals and software, plus personnel dedicated to perform report generation functions. It is assumed that each plant will require a computer for reporting at a cost of $3,000 to $4,000 or $3,500 on average, per location, which includes peripherals and necessary software.

Table 3.2 indicates an estimated cost for reporting of $2,500 per plant for plants with one sampling point in the Quarries and the Sand and Gravel categories. It is assumed that the initial report will cost $1,500 per plant, while the remaining $1,000 per plant will cover the cost of monthly reporting of data. These cost estimates for the initial report and monthly reporting are assumed to apply to those plants in the Quarries category that will carry out monitoring activities as well as to all plants in the Clay and Shale and the Sand and Gravel categories.

It is assumed that non-monitoring sites in the Quarries category will incur a cost of $500 per plant for their required initial report. In the remaining categories, it is assumed that the initial report will cost $2,500 for each plant with a single sampling point. For plants in all industry categories, the estimated cost of the initial report is assumed to increase by $1,000 for each additional sampling point.

Apart from the three industry categories mentioned above, it is assumed that each plant with a single sampling point will face a cost of $1,800 for monthly reporting for the year. It is further assumed that additional sampling points will add $900 per effluent sampling point and $600 per storm water sampling point for the year.

The estimated costs associated with reporting are provided for each plant in Table A.4 of Appendix A. These costs are summarized by industry category in Table 3.6. The estimated cost of capital for reporting, covering the cost of computers and initial reports, totals $323,000. Monthly reporting, which is classified as an operating cost, is expected to cost $77,300 for the year.

3.9 Total Estimated Costs of the MISA Industrial Minerals Sector Monitoring Requirements

Table 3.7 presents a summary of the point estimates of operating and maintenance (O & M) costs by industry category and monitoring function. Estimated O & M costs for the sector total $1.8 million for the year. Analytical testing, which consists of characterization, routine analyses and toxicity testing, accounts for 49.4% of the total. Sampling activities account for another 37.7%. By industry category, estimated of

TABLE 3.6

FLOW MEASUREMENT AND REPORTING COSTS FOR THE YEAR (IN $1,000's)

INDUSTRY CATEGORY	FLOW MEASUREMENT		REPORTING COSTS		
	CAPITAL COSTS	O & M COSTS	COMPUTERS	INITIAL REPORTS	O & M COSTS
CEMENT CATEGORY		$23.9	$21.0	$20.0	$15.3
CHEMICAL LIME CATEGORY	$10.0	$59.3	$21.0	$15.0	$10.8
CLAY AND SHALE CATEGORY		$5.5	$17.5	$7.5	$5.0
GRAPHITE CATEGORY		$7.6	$7.0	$7.0	$5.1
GYPSUM CATEGORY		$10.9	$10.5	$9.5	$7.2
MAGNESIUM CATEGORY		$3.3	$3.5	$3.5	$2.4
QUARRIES CATEGORY		$30.7	$70.0	$68.0	$20.9
SAND AND GRAVEL CATEGORY		$8.3	$21.0	$9.0	$6.0
TALC CATEGORY		$4.3	$7.0	$5.0	$3.6
SECTOR TOTALS:	$10.0	$153.8	$178.5	$144.5	$76.3

SOURCE: Table A.4 in Appendix A.

total O & M costs for the year range from $49,300 for the Magnesium category to $415,300 for the Quarries category.

As noted in the previous sections, the only intended capital expenditures related to the Monitoring Regulations which have been reported to date are for flow measurement devices. In addition, estimates are provided of capital expenditures required for reporting. Estimates of capital expenditures are presented in Table 3.6 and total $333,000, of which $10,000 is for flow measurement and $323,000 is for reporting. Estimates of total capital costs by industry category range from $7,000 for the Magnesium category to $138,000 for the Quarries category.

Table 3.7 also includes capital costs and total costs by monitoring function. Analytical testing accounts for 41.7% of total costs, while sampling activities account for another 31.8%. Because of the anticipated capital costs for reporting, this monitoring function accounts for 18.9% of total costs but only for 4.3% of O & M costs.

Point estimates of total and average plant cost by industry category are presented in Table 3.8 for anticipated O & M costs, capital costs and total costs of monitoring. The cost estimates are subject to uncertainties and contingencies which are accounted for with an allowance of plus or minus 20%, giving rise to the minimum and maximum cost estimates in Table 3.8. The estimates are also subject to change as additional information about intended capital expenditures, sampling points or other factors come to light.

The total cost of monitoring for the industrial minerals sector is expected to be between $1.7 million and $2.5 million for the year, based on a point estimate of $2.1 million. The Quarries category is expected to bear the largest share of costs, 26.2% of the sector total. Next in their share of sector costs are the Cement category with 21.5% of total anticipated costs and the Chemical Lime category with 17.2%.

The 94 plants in the Quarries category face the lowest average cost of monitoring, at about $5,900 for the year per plant, of which $4,400 is O & M costs. The next lowest anticipated cost per plant is faced by the Clay and Shale category, at $20,000 for the year, followed by the Sand and Gravel category, at $21,500 for the year. Plants in both

TABLE 3.7

SUMMARY OF ESTIMATED ANNUAL OPERATING AND MAINTENANCE COSTS AND TOTAL COSTS BY ANALYTICAL FUNCTION (IN $1,000's)

INDUSTRY CATEGORY	SAMPLING	ROUTINE ANALYSES	CHARACTERIZATION ANALYSES	TOXICITY TESTS	FLOW MEASUREMENT	REPORTING	TOTAL
CEMENT CATEGORY	$170.3	$120.5	$71.2	$13.2	$23.9	$15.3	$414.3
CHEMICAL LIME CATEGORY	$131.3	$68.4	$40.9	$7.2	$59.3	$10.8	$317.9
CLAY AND SHALE CATEGORY	$12.9	$10.9	$34.5	$6.0	$5.5	$5.0	$74.8
GRAPHITE CATEGORY	$52.5	$41.6	$19.4	$3.6	$7.6	$5.1	$129.8
GYPSUM CATEGORY	$81.2	$51.4	$33.0	$6.0	$10.9	$7.2	$189.7
MAGNESIUM CATEGORY	$22.9	$12.7	$6.9	$1.2	$3.3	$2.4	$49.3
QUARRIES CATEGORY	$129.4	$119.5	$101.5	$13.2	$30.7	$20.9	$415.3
SAND AND GRAVEL CATEGORY	$27.9	$26.3	$27.0	$3.6	$8.3	$6.0	$99.2
TALC CATEGORY	$43.8	$24.2	$14.0	$2.4	$4.3	$3.6	$92.3
SECTOR O & M TOTALS ($):	$672.2	$475.6	$348.3	$56.4	$153.8	$76.3	$1,782.6
(%):	37.7%	26.7%	19.5%	3.2%	8.6%	4.3%	100.0%
CAPITAL COSTS:					$10.0	$323.0	$333.0
TOTAL COSTS ($):	$672.2	$475.6	$348.3	$56.4	$163.8	$399.3	$2,115.6
(%):	31.8%	22.5%	16.5%	2.7%	7.7%	18.9%	100.0%

SOURCES: Tables A-1, A-2, A-3, and A-4.

TABLE 3.8

SUMMARY BY INDUSTRY CATEGORY OF TOTAL ESTIMATED COSTS RELATED TO THE MONITORING REGULATION (IN $1,000's)

INDUSTRY CATEGORY	O & M COSTS	CAPITAL COSTS	TOTAL COSTS			
			Min.	Point Est.	Max.	%
CEMENT CATEGORY	$414.3 ($69.0)	$41.0 ($6.8)	$364.2 ($60.7)	$455.3 ($75.9)	$546.3 ($91.1)	21.5%
CHEMICAL LIME CATEGORY	$317.9 ($53.0)	$46.0 ($7.7)	$291.1 ($48.5)	$363.9 ($60.6)	$436.6 ($72.8)	17.2%
CLAY AND SHALE CATEGORY	$74.8 ($15.0)	$25.0 ($5.0)	$79.8 ($16.0)	$99.8 ($20.0)	$119.7 ($23.9)	4.7%
GRAPHITE CATEGORY	$129.8 ($64.9)	$14.0 ($7.0)	$115.1 ($57.5)	$143.8 ($71.9)	$172.6 ($86.3)	6.8%
GYPSUM CATEGORY	$189.7 ($63.2)	$20.0 ($6.7)	$167.8 ($55.9)	$209.7 ($69.9)	$251.6 ($83.9)	9.9%
MAGNESIUM CATEGORY	$49.3 ($49.3)	$7.0 ($7.0)	$45.1 ($45.1)	$56.3 ($56.3)	$67.6 ($67.6)	2.7%
QUARRIES CATEGORY	$415.3 ($4.4)	$138.0 ($1.5)	$442.6 ($4.7)	$553.3 ($5.9)	$664.0 ($7.1)	26.2%
SAND AND GRAVEL CATEGORY	$99.2 ($16.5)	$30.0 ($5.0)	$103.3 ($17.2)	$129.2 ($21.5)	$155.0 ($25.8)	6.1%
TALC CATEGORY	$92.3 ($46.2)	$12.0 ($6.0)	$83.5 ($41.7)	$104.3 ($52.2)	$125.2 ($62.6)	4.9%
SECTOR TOTALS:	$1,782.6	$333.0	$1,692.5	$2,115.6	$2,538.7	100.0%

NOTE: Average costs per plant in each category are given in brackets. Minimum Total Cost is 20% below the Point Estimate, while Maximum Total Cost is 20% above the Point Estimate. The percentage of Total Cost by industry category is based on the Point Estimates.

SOURCES: Tables 3.6 and 3.7.

of these categories are expected to incur capital costs of $5,000 per plant. The difference in average cost for the Quarries category and the next lowest cost categories results from the use of a representative sampling of 20 quarries, with the remaining quarries designated as non-monitoring sites but sharing the costs.

Plants in the Cement category face the highest average cost of monitoring, at about $75,900 per plant for the year. Of this amount, O & M costs of $69,000 are anticipated. Graphite plants face average costs of $71,900 per plant, of which $64,900 are for O & M costs. Average total costs of $69,900 per plant are faced by plants in the Gypsum category.

Most of the plants in the three low cost categories will have to test at most once per week, while plants in the remaining categories will have to test three times per week. Most plants in the three high cost categories are believed to have two sampling points, while most of the remaining plants have only one.

Total costs by plant are presented in Table A.5 in Appendix A. North Coast Industries Limited, a graphite plant, faces the highest anticipated cost in the sector, which are expected to be between $66,800 and $100,200 for the year. Five of the six cement plants are likely to face the next highest costs, at between $64,400 and $97,000 for the year.

The lowest costs in the sector will be faced by 90 plants in the Quarries category, based on the cost sharing arrangement discussed above. These plants will face costs of between $4,000 and $6,100 per plant for the year. The remaining plants in this category have agreed to pay their own costs: Indusmin faces expected costs of between $18,200 and $27,200 in total for its three quarries, while 3M Canada faces a total cost of between $60,300 and $90,500 for the year. The latter plant has two sampling points and is subject to more frequent testing as a result of findings from pre-regulation monitoring and because its wash water sampling point does not have a settling pond.

The total costs discussed in this sector provide a basis for the analysis of financial and economic impacts of the Regulation in Chapter 4. First, the following sector discusses costs of some options that were considered in the process of determining the draft Regulation that is the basis of this report.

3.10 Cost Estimates of Alternative Monitoring Options

The Industrial Minerals Sector Regulation specifies stream-specific testing requirements by industry category. The choice of sampling frequencies and sampling procedures is discussed in Ontario Ministry of the Environment (1989a). This discussion acknowledges that the decision to select 20 plants in the Quarries category for representative sampling was made so as to reduce costs to the small plants and firms in this industry category. Likewise, the decision to allow grab samples for those plants in the Quarries and the Sand and Gravel categories with settling ponds was made so as to reduce costs to plants in these categories (Three-grab composite samples, or composite samples taken automatically, are required for the other effluent sampling points in the sector). It is felt that, in both cases, the cost saving can be made without significantly sacrificing the quality of information about effluents.

This section provides estimates of the differences in costs to the various industry categories under several alternative monitoring options. First, estimates are provided of the additional costs that would be imposed on the Quarries category if all 94 plants were required to carry out monitoring activities. Second, estimates are provided of the additional costs that would be imposed on the Quarries and the Sand and Gravel categories if three-grab composite samples were required of all plants. Third, estimates are provided of the cost saving that would result if all plants were permitted to take grab samples rather than three-grab composite samples.

Of the 94 plants in the Quarries category, 74 are currently designated as non-monitoring sites. From Tables A.1, A.2, A.3 and A.4 in Appendix A, it can be determined that the point estimate of total cost of monitoring for a plant with one quarry water sampling point and a settling pond amounts to $22,100. The total cost per plant for plants with one wash water sampling point and a settling pond is $21,700. Costs are expected to increase by

$18,000 for any plant that does not have a settling pond. The only costs arising from non-monitoring sites is $500 per plant for a simplified initial report.

The following assumptions are made for the purpose of estimating the additional costs that would be imposed if all quarries were required to undertake monitoring: (1) that 50 of the non-monitoring sites have a single quarry water sampling points while 24 have a single wash water sampling points; and (2) that all 74 plants have settling ponds. The additional cost to most plants in this category would increase from $5,100 under the proposed Regulation to $21,700 for those plants with wash water sampling points and to $22,100 for those plants with quarry water sampling points. The additional cost to the Quarries category would total $1.6 million (i.e., 50 x ($22,100 - $500) + 24 x ($21,700 - $500)). The additional cost to individual plants, and to the sector as a whole, would be higher in the event that some plants have more than one sampling point or lack a settling pond.

Costs associated with labour requirements for sampling are shown in Table 3.2 and discussed in Section 3.2 above. It is estimated that each plant with a single sampling point in the Quarries and the Sand and Gravel categories will face a cost for this purpose of $1,542 for the year. If three-grab composite samples were required rather than grab sampling, the estimated cost would increase to $4,680 per plant for the year (i.e., 6 hours x 52 weeks = 312 hours @ $15/hour). The difference amounts to $3,120 per plant for the year.

Based on representative sampling by 20 plants, the additional cost to the sector would total $78,000. Of this amount, each of the six plants in the Sand and Gravel category, as well as the 3M Canada and Indusmin quarries, would face an additional $3,120 for the year, while the remaining $53,040 would be shared equally by the other 90 quarries.

If all 94 plants in the Quarries category were required to carry out monitoring activities, the additional cost to the sector resulting from the elimination of grab sampling would increase by $230,880 to a total of $308,880 (i.e., 74 x $3,120 + $78,000). In this case, the total additional cost to the sector would amount to $1.9 million. Most plants in this category would face total costs of about $25,000 for the year (i.e., $3,120 + either $22,100 or $21,700), as compared to $5,100 under the proposed Regulation. Any quarries without settling ponds would face costs of about $40,000 for the year but would be unaffected by the elimination of grab sampling; they are already required to take three-grab composite samples under the proposed Regulation.

In contrast, the estimated saving in sampling costs for the sector would amount to $205,920 for the year if grab samples were permitted for all sampling points in the sector. Apart from 3M Canada and Woods Sand and Gravel, plants in the Quarries, the Sand and Gravel, and the Clay and Shale categories would be unaffected. For the remaining 22 plants in the sector, the estimated labour time required for sampling would be reduced by 12 hours per week or 624 hours per year based on Table 3.2. The total savings indicated above derive from a saving of $9,360 per plant for the year (i.e., 624 hours @ $15/hour) for each of the 22 plants.

It was felt that the potential cost savings that might result by allowing grab samples would not be sufficient to justify the possible reduction in quality of monitoring data. Without the mixing which takes place in settling ponds with retention times of at least 24 hours, the use of grab samples would increase the risk of introducing systematic bias into the results.

4.0 ECONOMIC EFFECTS AND IMPLICATIONS OF MONITORING COSTS

4.1 Analytical Approach

In this section, the economic effects of the extra capital and operating costs incurred by firms liable to the MISA monitoring regulations are evaluated. Determination of firm-specific quantitative effects is limited by available data but a number of insights and conclusions about these implications will be derived on the basis of the structural characteristics of each product subsector.

Faced with increases in externally-imposed operating and capital costs, a firm will initially redirect funds from other purposes to pay for the new expenses. These funds will ultimately be derived from one of two sources: increased revenues resulting from higher prices for the firm's products or reduced profits when prices cannot be raised. Higher prices would be borne by consumers while lower profits would affect the firm's owners.

A firm's employees would not generally encounter reduced wages or incomes as a direct result of abatement expenditures unless the firm closed all or part of its operations. In fact, many environmental protection activities imply additional employee effort. However, it is not certain whether the affected firms will establish new positions for these tasks or reallocate activities among existing staff.

Where higher costs cannot be passed on as higher prices, the general public will share a portion of these costs through reductions in profits taxes paid to the federal and provincial governments.

The analytical approach taken here consists of two parts. First, the market structure in the industry categories will be assessed with regard to firms' ability to increase prices. The aim is to provide an indication of whether firms will be able to pass extra costs on to customers as higher product prices. Second, the maximum potential impact of estimated costs of monitoring will be derived, both on average commodity prices and, alternatively, on selected financial performance indicators. As noted, the key features of each category are described in Appendix B.

The derivation of the maximum potential impact of monitoring costs on average prices makes use of information on volume and value of production by industry category that was presented in Chapter 2. For each industry category for which data are available, the average cost of monitoring per unit of output is computed and compared to the unit (average) price for that category. Regional differences may permit some firms within a category to increase prices much more than can other firms, but information on market structure of sufficient detail of assess such differences was not available for this report.

For comparison, the impact of monitoring costs is analyzed based on the assumption that firms cannot pass along costs through higher prices, so that all monitoring costs will be absorbed by the relevant firms. The analysis will show how the extra monitoring costs would change after-tax profits, capital expenditures and return on capital employed if they had been incurred during the worst of the past six years and against the average of these performance measures over the past three to six years. These analyses revel the extent to which monitoring costs would reduce a company's performance measures below its own historical averages. Moreover, comparisons can be made with these same financial performance measures for the industry category as a whole where aggregate statistics are available.

While plant-specific analyses of effects using data on revenues, costs and production would be the most accurate, plant-specific financial data are generally not available. As noted, company-specific data are publicly available for only 11 of the 72 firms which operate plants in the industrial minerals sector. Selected financial statistics for these companies, and in some cases for their parent corporations or operating divisions, appear in Table 2.1. These 11 companies operate 29 plants in six of the nine industry categories; no corporate information is available for plants in the Graphite, the Sand and Gravel, and the Talc categories.

Estimates of total costs of monitoring by plant for these public corporations is summarized in Table 4.1. Four of these firms (Dofasco Inc., Domtar Inc., Falconbridge Limited and Stelco Inc.) operate plants in other sectors that are subject to MISA Monitoring Regulations. Estimates of their anticipated costs of monitoring in the other MISA sectors are also included in Table 4.1

TABLE 4.1: SUMMARY OF COSTS RELATED TO THE MONITORING REGULATIONS BY FIRM, FOR SELECTED FIRMS (IN $1,000's)

FIRM / PLANT	INDUSTRY CATEGORY	O & M COSTS	CAPITAL COSTS	TOTAL COSTS Min.	TOTAL COSTS Point Est.	TOTAL COSTS Max.
A. Brampton Brick Ltd.						
13. Brampton Brick Ltd.	C&S	$15.0	$5.0	$16.0	$20.0	$23.9
B. CGC Inc.						
20. CGC Inc.	Gy	$72.4	$7.0	$63.6	$79.4	$95.3
C. Dofasco Inc.						
7. BeachviLime Limited (East Plant)	CL	$47.0	$6.0	$42.4	$53.0	$63.6
8. BeachviLime Limited (West Plant)	CL	47.0	6.0	42.4	53.0	63.6
9. Guelph DoLime Limited	CL	47.0	6.0	42.4	53.0	63.6
Total Industrial Minerals Sector costs:		$140.9	$18.0	$127.1	$158.9	$190.7
+ MISA Iron and Steel Sector costs:		1,588.0	3,332.0			
+ MISA Mineral Group "A" Sector costs:		188.0	83.0			
TOTAL MISA MONITORING COSTS:		$1,916.9	$3,433.0			
D. Domtar Inc.						
21. Domtar Construction Materials	Gy	$72.4	$7.0	$63.6	$79.4	$95.3
+ MISA Organic Chemical Sector costs:		205.0	62.0			
+ MISA Mineral Group "A" Sector costs:		137.0	59.0			
+ MISA Pulp and Paper Sector costs:		771.0	1,627.0			
TOTAL MISA MONITORING COSTS:		$1,185.4	$1,755.0			
E. Falconbridge Limited						
60. Indusmin - Blue Mountain	Q	$16.7	$5.0	$17.3	$21.7	$26.0
61. Indusmin - Nephton	Q	0.0	0.5	0.4	0.5	0.6
62. Indusmin - Badgeley Island	Q	0.0	0.5	0.4	0.5	0.6
Total Industrial Minerals Sector costs:		$16.7	$6.0	$18.1	$22.7	$27.2
+ MISA Mineral Group "A" Sector costs:		1,275.0	463.0			
+ MISA Metal Casting Sector costs:		17.0	7.0			
TOTAL MISA MONITORING COSTS:		$1,308.7	$476.0			
F. Jannock Limited						
14. Canada Brick Company - Burlington	C&S	$15.0	$5.0	$16.0	$20.0	$23.9
15. Canada Brick Company - Cooksville	C&S	15.0	5.0	16.0	20.0	23.9
16. Canada Brick Company - Gloucester	C&S	15.0	5.0	16.0	20.0	23.9
17. Canada Brick Company - Streetsville	C&S	15.0	5.0	16.0	20.0	23.9
		$59.8	$20.0	$63.9	$79.8	$95.8

...Continued

TABLE 4.1 (Continued)

FIRM / PLANT	INDUSTRY CATEGORY	O & M COSTS	CAPITAL COSTS	TOTAL COSTS		
				Min.	Point Est.	Max.
G. Lafarge Canada Inc.						
1. LaFarge Canada Inc. - Bath	C	$73.8	$7.0	$64.7	$80.8	$97.0
2. LaFarge Canada Inc. - Woodstock	C	73.8	7.0	64.7	80.8	97.0
52. Francon Div. of Lafarge Canada Inc.	Q	3.7	1.4	4.0	5.1	6.1
80. Permanent Concrete - Brockville Quarry	Q	3.7	1.4	4.0	5.1	6.1
81. Permanent Concrete - Cornwall Quarry	Q	3.7	1.4	4.0	5.1	6.1
82. Permanent Concrete - Hawthorne Quarry	Q	3.7	1.4	4.0	5.1	6.1
83. Permanent Concrete - Navan Quarry	Q	3.7	1.4	4.0	5.1	6.1
84. Permanent Concrete - Orleans Quarry	Q	3.7	1.4	4.0	5.1	6.1
85. Permanent Concrete - Selby Quarry	Q	3.7	1.4	4.0	5.1	6.1
86. Permanent Concrete - Violet Road Quarry	Q	3.7	1.4	4.0	5.1	6.1
		$176.9	$25.2	$161.7	$202.1	$242.5
H. St. Lawrence Cement Inc.						
4. St. Lawrence Cement Inc.	C	$45.2	$6.0	$40.9	$51.2	$61.4
47. Dufferin Aggregates	Q	3.7	1.4	4.0	5.1	6.1
91. St. Lawrence Cement Inc.	Q	3.7	1.4	4.0	5.1	6.1
		$52.5	$8.8	$49.0	$61.3	$73.5
I. Stelco Inc.						
12. Stelco Chemical Lime Works	CL	$66.3	$11.0	$61.9	$77.3	$92.8
+ MISA Iron and Steel Sector costs:		1,291.0	1,490.0			
TOTAL MISA MONITORING COSTS:		$1,357.3	$1,501.0			
J. 3M Canada Inc.						
103. 3M Canada Inc.	Q	$69.4	$6.0	$60.3	$75.4	$90.5
K. Timminco Limited						
23. Timminco Ltd.	Mg	$49.3	$7.0	$45.1	$56.3	$67.6

NOTE: C = Cement category; CL = Chemical Lime category; C&S = Clay and Shale category
Gy = Gypsum category; Mg = Magnesium category; Q = Quarries category

SOURCE: Table A.5 in Appendix A, and discussion in Section 3.9, and Ontario Ministry of the Environment (1989c,d,e,f,g) for cost estimates for other MISA Sectors.

In addition, estimates of average (per plant) revenue, cost and profit were developed for some industry categories using information from the Annual Census of Mines, Quarries and Sand Pits, 1987. These estimates are used as an alternative means of assessing the potential impacts of the estimated costs of monitoring. The results of this procedure cannot be taken as precise estimates of effects on individual firms or plants, but they do provide some indication of the impacts of monitoring costs on various industry categories.

Where long term investment decisions are concerned, a key economic variable is the rate of return on investment or capital employed. This is the return that provides the incentive for owners and investors to remain in a particular enterprise or to move their capital on to something else that may be more profitable. In this study, the Statistics Canada definition of return on capital employed was used in which the ratio is equal to:

$$\frac{\text{After-tax Profits + Interest Payments + Extraordinary Expenses}}{\text{Total Assets - Current Liabilities}}$$

Consequently, the first analysis will show how the potentially recurring operating costs of monitoring would have affected the rate of return on capital employed for individual firms and for the industry category as a whole where data are available.

For this analysis, operating costs of monitoring are first reduced by the amount of the appropriate corporate tax rate because part of these costs are offset by reduced income taxes. The adjusted incremental operating cost of monitoring is then subtracted from after-tax profits to determine a new rate of return on capital employed. This calculation is carried out for each firm in each year for which data are available. The new rates of return can then be compared with average rates of return for the industry as well as each firm's historical performance records.

A second analysis determines the proportion that operating costs of monitoring make up of after-tax profits. This indicates what would happen if all operating costs were absorbed by the firm as a reduction in after-tax profits. This calculation yields an over-estimate of the effect because operating costs of monitoring are not reduced by the corporate tax rates as is done in the previous analysis.

A third analytical procedure is carried out to determine the extent to which capital requirements for monitoring would divert capital expenditure away from other uses. Estimated capital costs of monitoring are thus computed as a percent of total capital expenditures for each firm in each year for which capital expenditure data are available. There is no rule of thumb as to what proportion of capital expenditures should be devoted to environmental protection in any given year. Some industrial representatives assert that a minimum capital expenditure is necessary to carry out a sufficient amount of repair and replacement in order to keep a plant running. These basic expenditures apparently vary from industry to industry and from firm to firm.

This comparison of expected capital expenditures to actual outlays is conservative in that it overstates the potential diversion of funds in a given year. Capital costs are normally depreciated over three to five years so that only a proportion of the actual expenditure would be deducted each year, not the full amount that is used in the present analysis.

International competitiveness can be affected by environmental expenditures to the extent that firms may be unable to maintain product quality or pass along cost increases in the face of international market-determined competitive prices. As noted in Appendix B, those industrial minerals commodities with low value to weight ratios (e.g., stone, lime, gravel, sand) are limited to local markets by transportation costs. Cement, graphite, magnesium and talc are more widely traded internationally so that prices are more sensitive to international forces. Therefore, extra costs are more likely to affect firms' competitiveness in these relatively high value-to-weight categories than in those categories in which sales are largely limited to local markets. Even in the latter case, individual firms may suffer a loss of competitiveness to the extent that competing firms serving the same area are not direct dischargers subject to the costs of monitoring.

These analyses are by no means definitive, but they can identify those industry categories which could experience financial effects that are large relative to their historical performance. Similarly, with the use of the financial data for public corporations, it may be possible to identify particular firms which could experience financial effects that are large relative to (a) their own historical performance; (b) other firms' performance; and/or (c) performance of the industry as a whole.

4.2 Overview of Economic and Financial Implications

As noted in the previous section, the impacts of the additional costs resulting from the Monitoring Regulations will depend on market concentration for the various products in the industrial minerals sector. Firms will be able to pass along most of the additional costs as price increases when they exercise a high degree of monopoly power in their markets or when a very large share of total output is subject to costs of monitoring. Otherwise, owners of firms are likely to bear most of the costs through reduced profits, thereby reducing tax revenues from taxes on corporate profits.

Before discussing the market structure of the industry categories in the industrial minerals sector, it is useful to indicate the potential impact of monitoring costs on prices in this sector. Table 4.2 shows the unit values (i.e., average prices) during the 1980's and the incremental cost of monitoring per unit of output for selected sector commodities. The information required to compute unit values is not available for commodities in all industry categories. Estimates of total cost of monitoring per unit of output, expressed as a percentage of average unit value, range from about 0.1% for magnesium and for sand and gravel to about 1.7% for gypsum and for talc. These percentage figures provide a reasonable indication of the maximum potential impacts of the Monitoring Regulations on prices in this sector.

A description of the industrial minerals sector is provided in Chapter 2, while Appendix B provides further details on the individual industry categories in the sector. A common characteristics of the products produced in this sector is relatively low value to volume of output. For this reason, transport costs can account for a substantial share of the delivered price.

Local markets, rather than provincial, national or international markets, are likely to be of greatest relevance for assessing market structure. However, detailed information on local market conditions is

TABLE 4.2

UNIT VALUES AND ESTIMATED INCREMENTAL COSTS OF MONITORING FOR SELECTED PRODUCTS IN THE INDUSTRIAL MINERALS SECTOR (IN DOLLARS PER TONNE)

CEMENT			CHEMICAL LIME				GYPSUM			MAGNESIUM [*]		
UNIT VALUE	INCREMENT		UNIT VALUE	INCREMENT		YEAR	UNIT VALUE	INCREMENT		UNIT VALUE	INCREMENT	
$75.37	$0.11	0.15%	$71.01	$0.22	0.30%	1980	$12.44	$0.28	2.28%	$4.83	$0.01	0.11%
78.66	0.12	0.15%	74.93	0.20	0.26%	1981	12.24	0.32	2.64%	5.00	0.01	0.12%
80.30	0.15	0.19%	70.17	0.24	0.34%	1982	12.54	0.37	2.91%	4.76	0.01	0.14%
81.67	0.14	0.17%	69.31	0.23	0.33%	1983	13.50	0.23	1.71%	4.53	0.01	0.18%
74.70	0.13	0.17%	70.76	0.22	0.31%	1984	12.77	0.18	1.39%	4.84	0.01	0.13%
74.80	0.11	0.15%	75.98	0.22	0.29%	1985	15.42	0.19	1.22%	4.91	0.01	0.12%
73.84	0.09	0.13%	65.81	0.23	0.35%	1986	13.97	0.16	1.14%	5.09	0.01	0.11%
80.74	0.08	0.10%	70.81	0.23	0.32%	1987	11.78	0.14	1.21%	4.67	0.01	0.11%
82.53	0.08	0.10%	68.88	0.22	0.32%	1988	13.51	0.14	1.06%	N.A.	N.A.	N.A.
$78.07	$0.11	0.15%	$70.85	$0.22	0.31%	AVERAGE	$13.13	$0.22	1.70%	$4.83	$0.01	0.13%

STONE			SAND AND GRAVEL				TALC		
UNIT VALUE	INCREMENT		UNIT VALUE	INCREMENT		YEAR	UNIT VALUE	INCREMENT	
$5.46	$0.02	0.28%	$2.77	$0.002	0.06%	1980	$170.44	$6.52	3.83%
4.91	0.01	0.30%	2.78	0.002	0.07%	1981	$209.17	$5.80	2.77%
5.08	0.02	0.38%	2.84	0.002	0.08%	1982	$224.05	$5.22	2.33%
5.22	0.02	0.31%	2.76	0.002	0.09%	1983	$226.18	$3.16	1.40%
5.15	0.01	0.26%	2.81	0.002	0.08%	1984	$234.98	$2.43	1.03%
5.27	0.01	0.23%	2.80	0.002	0.07%	1985	$228.83	$2.17	0.95%
4.96	0.01	0.21%	3.15	0.002	0.05%	1986	$207.96	$1.90	0.91%
4.61	0.01	0.19%	3.20	0.001	0.04%	1987	$173.53	$1.80	1.04%
5.03	0.01	0.19%	2.90	0.001	0.04%	1988	N.A.	N.A.	N.A.
$5.08	$0.01	0.26%	$2.89	$0.002	0.06%	AVERAGE	$209.39	$3.62	1.73%

NOTE: The indicated increment in unit value is based on the point estimate of the total cost of monitoring and the total volume of production each year. The impact for individual firms and local markets is likely to differ from the product averages.
"N.A." = Not Available.
[*] Unit value and increments are in dollars per kilogram.

SOURCE: Table 3.8 and Ontario Ministry of Northern Development and Mines, 1989.

not generally available. Much of the following discussion related to industry categories is based on information for the province as a whole rather than for more localized markets. This qualification is of particular concern for those industry categories which include a substantial number of firms which are not direct dischargers subject to the Monitoring Regulations.

4.3 Analyses by Industry Category

Cement

The six plants in the Cement category account for the entire production of gray Portland cement in Ontario. The sole Canadian plant which produces white Portland cement, located in Woodstock, Ontario, is not subject to the Monitoring Regulations. However, the latter plant accounts for only 2% of total Portland cement clinker capacity in Ontario of 6.8 million short tonnes per year (Portland Cement Association). With 98% of Ontario's cement capacity in plants subject to the Monitoring Regulations, it is likely that substantially all of the costs of monitoring could be passed on in price increases.

Chemical Lime

The six plants in the Chemical Lime category account for 77% of Ontario's 1988 calcining capacity of 2.3 million tonnes per year, but the remaining 23% is entirely for captive use (Energy, Mines and Resources Canada, 1989; page 36.7). A new 30,000 tonne-per-year plant, located in Dryden and scheduled for completion during 1989, is not subject to the Monitoring Regulation. However, this plant is unlikely to compete in the local markets of the six plants which are subject to the Monitoring Regulation both because of its relatively small size and because lime is usually sold within a 300 kilometre radius of production (Energy, Mines and Resources Canada, 1989; page 36.1). Consequently, it is likely that firms in this category will be able to pass along substantially all of the incremental costs of monitoring in price increases. Because the plants owned by Dofasco account for 58% of the portion of Ontario capacity that is not destined for captive use, Dofasco's internal pricing strategy may dictate the extent to which monitoring costs affect prices in this category.

Clay and Shale

The five plants in the Clay and Shale category appear to account for a substantial share of building brick production in Ontario (Energy, Mines and Resources Canada, 1989; page 31.10). Jannock Limited, the parent corporation of Canada Brick Company, is the largest producer of clay brick in North America, and its Canadian brick operations currently control over 70% of the clay brick manufacturing capacity in central Canada (Jannock Limited, Annual Report 1988). Brampton Brick Limited has completed a new brick plant which is the largest and most modern of its kind in North America (Brampton Brick Limited, Annual Report 1988). It appears likely that the firms in this category will be able to pass along substantially all of the incremental costs of monitoring in price increases because of the high degree of concentration in the industry.

Graphite

There has been no production of graphite in Ontario through 1988. Both plants in the Graphite category are expected to begin operations during the coming year. Imports provide for nearly all of Canada's current consumption of graphite. In addition, natural graphite is widely distributed throughout the world (Energy, Mines and Resources Canada, 1989; chapter 31). Consequently, the ability of firms in the category to pass along higher costs through price increases is likely to be quite limited, and their profits will likely be reduced by monitoring and environmental protection costs.

Gypsum

The three plants in the Gypsum category account for the entire production of gypsum in Ontario. The entire gypsum output from each plant supplies an affiliated wallboard plant. Westroc Industries Limited ships gypsum from its Drumbo plant to its Mississauga wallboard plant, while the other two plants have wallboard plants on site. Wallboard, like most other gypsum products, generally has a limited market range because of the high cost of transportation and other factors, and wallboard markets are generally supplied by the nearest producer (Energy, Mines and Resources Canada, 1989; chapter 32). Consequently, it is likely that the firms in this category will pass along most of the additional costs of monitoring as higher downstream prices for wallboard.

Magnesium

Timminco Limited has been the only producer of primary magnesium in Canada through 1988. However, a major new plant in Quebec was expected to begin operations in the middle of 1989. Also, there is substantial international trade in magnesium, and at present, there is excess production capacity worldwide (Energy, Mines and Resources Canada, 1989; chapter 38). Consequently, it appears that Timminco will be unable to pass along more than a small portion of the additional costs of monitoring through to higher prices, and its profits are likely to be reduced by the costs of monitoring.

Quarries

The ability of firms in the Quarries category to pass along the costs of monitoring as higher product prices will depend on local market conditions and on the particular product. Firms will be less likely to increase prices when they face competing quarries in their local markets which are not subject to monitoring costs. Information about the local market conditions for the plants in this category is not available.

Sand and Gravel

The six plants in the Sand and Gravel category constitute a very small percentage of the total number of sand and gravel pits in Ontario. Nonetheless, any of the six plants may be able to increase prices to the extent that local competition is limited. There is no information available with which to assess the local markets for these plants.

Talc

The two plants in the Talc category account for the entire production of talc in Ontario. Ontario produced 63% of Canada's talc output in 1987. International trade in talc is limited because talc deposits are widespread throughout the world (Ontario Ministry of Northern Development and Mines, 1988). Still, the two firms in this category may find it difficult to raise prices to compensate for the costs of monitoring because there is currently substantial excess capacity in this industry.

4.4 Impacts on Selected Financial Indicators

As noted in the paragraphs above, it is likely that prices rather than profits will be affected for many of the industry categories in the industrial minerals sector. Still, it is useful to determine the extent to which profits may be affected by the costs arising from the Monitoring Regulation. The remainder of this section examines the potential impacts of the costs of monitoring on the profits of the firms in this sector.

Table 4.3 presents a summary for the firms for which data are currently available of the possible percentage reduction in the rate of return on capital employed that could result if all of the monitoring costs had to be paid out of profits. On average, the operating costs of monitoring of industrial minerals plants, shown in Table 4.1, would reduce the company rates of return by no more than 0.07% over the six year period of the analysis. For the four firms in this sector which operate plants in other MISA sectors, the total operating costs of monitoring for all MISA sectors would reduce the company rates of return by no more than 0.05%.

Table 4.4 presents a summary of the effects of anticipated monitoring costs on capital expenditures and on after-tax profits (net earnings) for the 11 public corporations in the sector. Point estimates (average values) of expected capital and operating costs of monitoring, as reported in Table 4.1, were used in the calculations. Percentages are computed for the average, lowest and highest annual capital expenditures and net earnings of each firm during the period from 1983 to 1988.

Table 4.4 shows that estimated capital costs of monitoring for the industrial minerals sector requirements amount to 2.4% or less of total capital expenditures in any one one year during the period for the 11 companies. The 2.4% figure occurs for Brampton Brick Limited in its full year prior to becoming a public company. Otherwise, the estimated capital costs amount to less than 1.0% of total capital expenditures. Moreover, the estimated capital costs of monitoring amount to less than 0.2% of average annual capital expenditures by any of the firms during the period.

TABLE 4.3

PROJECTED DIFFERENCES IN THE RATES OF RETURN ON CAPITAL EMPLOYED AS A RESULT OF THE ESTIMATED OPERATING COSTS OF MONITORING FOR SELECTED FIRMS (DIFFERENCES, IN PER CENT)

FIRM	1983	1984	1985	1986	1987	1988	AVERAGE
A. Brampton Brick Ltd.	n.a.	n.a.	n.a.	n.a.	-0.02%	-0.01%	-0.02%
B. CGC Inc.	n.a.	-0.04%	-0.03%	n.a.	-0.05%	-0.04%	-0.04%
C. Dofasco Inc.							
Industrial Mineral sector only:	**	**	**	**	**	**	**
Including all MISA sectors:	-0.06%	-0.06%	-0.05%	-0.05%	-0.04%	-0.03%	-0.05%
D. Domtar Inc.							
Industrial Mineral sector only:	**	**	**	**	**	**	**
Including all MISA sectors:	-0.06%	-0.06%	-0.05%	-0.04%	-0.03%	-0.03%	-0.04%
E. Falconbridge Limited							
Industrial Mineral sector only:	**	**	**	**	**	**	**
Including all MISA sectors:	-0.07%	-0.07%	-0.06%	-0.03%	-0.03%	-0.03%	-0.05%
F. Jannock Limited	-0.02%	-0.02%	-0.02%	-0.01%	-0.01%	-0.01%	-0.02%
G. Lafarge Canada Inc.	-0.01%	-0.01%	-0.02%	-0.02%	-0.02%	-0.02%	-0.02%
H. St. Lawrence Cement Inc.	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%
I. Stelco Inc.							
Industrial Mineral sector only:	**	**	**	**	**	**	**
Including all MISA sectors:	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%
J. Minnesota Mining and Manufacturing Company [*]	n.a.	n.a.	n.a.	n.a.	**	**	**
K. Timminco Limited	-0.10%	-0.09%	-0.08%	-0.06%	-0.05%	-0.07%	-0.07%

NOTE: "n.a." = not available. Table 4.1 lists the relevant plants operated by each firm.
[*] Parent corporation of 3M Canada Inc.
[**] The projected difference is less than 0.005%.

SOURCE: Table 4.1, Corporate Annual Reports and Financial Post Information Service.

TABLE 4.4

SUMMARY OF IMPACTS OF MONITORING COSTS ON SELECTED FINANCIAL INDICATORS FOR PUBLIC CORPORATIONS IN THE INDUSTRIAL MINERALS SECTOR

	CAPITAL EXPENDITURES			AFTER-TAX EARNINGS		
	Monitoring Capital Cost as a % of Annual Capital Expenditure			Monitoring Operating Cost as a % of Annual After-Tax Earnings (Loss)		
FIRM	Average Year	Lowest Year	Highest Year	Average Year	Lowest Year	Highest Year
A. Brampton Brick Ltd.	0.05%	2.39%	0.02%	0.45%	1.45%	0.24%
B. CGC Inc.	0.16%	-0.19%	0.09%	0.19%	0.41%	0.14%
C. Dofasco Inc.	0.01%	0.03%	*	0.09%	0.12%	0.06%
Including all MISA sectors:	1.50%	6.52%	0.81%	1.26%	1.59%	0.86%
D. Domtar Inc.	*	0.01%	*	0.07%	0.18%	0.04%
Including all MISA sectors:	0.55%	1.63%	0.34%	1.12%	2.95%	0.74%
E. Falconbridge Limited	0.01%	0.02%	0.01%	0.02%	-0.47%	0.00%
Including all MISA sectors:	0.68%	1.96%	0.45%	1.31%	-36.95%	0.38%
F. Jannock Limited	0.06%	0.31%	0.03%	0.14%	0.48%	0.05%
G. Lafarge Canada Inc.	0.05%	0.18%	0.03%	0.35%	-0.77%	0.16%
H. St. Lawrence Cement Inc.	0.02%	0.09%	0.01%	0.12%	1.25%	0.06%
I. Stelco Inc.	0.01%	0.03%	*	0.14%	-0.47%	0.07%
Including all MISA sectors:	0.73%	4.63%	0.29%	2.93%	-9.53%	1.40%
J. 3M Canada Inc.	0.03%	0.05%	0.03%	0.21%	0.27%	0.13%
K. Timminco Limited	0.19%	0.85%	0.09%	2.50%	-1.22%	1.09%

NOTE: Estimates of monitoring costs in 1989 dollars are compared to selected financial statistics for 1983 - 1988 in current dollars. The Industrial Minerals sector plants operated by each firm are listed in Table 4.1.
[*] The projected difference is less than 0.005%.

SOURCE: Table 2.1 and Table 4.1.

When estimated capital costs in other MISA sectors are taken into account, the potential impacts are likely to be somewhat larger. Estimates of total capital costs of MISA monitoring for Dofasco Inc. amount to 6.5% of its 1983 capital expenditures and to 1.5% of its average capital expenditures during the past six years. For Stelco Inc., estimates of total capital costs of MISA monitoring amount to 4.6% of its 1984 capital expenditures and to 0.7% of its average capital expenditures. The analogous percentages for Domtar Inc. and for Falconbridge Limited are somewhat lower.

Table 4.4 also reveals the potential impacts of estimated sector operating costs of monitoring on net earnings. As was noted in the previous section, the actual impacts of these monitoring costs of net earnings or losses would be lower than the indicated percentages because tax payments would also be reduced.

Three of the 11 companies experienced net losses for a single year during the period, while Stelco experienced net losses in two years. The additional of monitoring costs would have slightly increased the losses incurred in those years. For the remaining firms, anticipated operating costs of monitoring for the sector requirements amount to less than 1.5% of net earnings for any year during the period. Estimated sector operating costs of monitoring correspond to less than 0.5% of average net earnings during the period, except that for Timminco Limited, they amount to 2.5% of average net earnings.

For the four firms which operate in other MISA sectors, the potential impact of operating costs of monitoring on net earnings will be considerably larger when total MISA monitoring costs are taken into account than when based on sector costs alone. The estimated total operating costs of monitoring for Stelco amount to 2.9% of its average net earnings during the six-year period.

Estimated operating costs of MISA monitoring for Dofasco and Falconbridge come to 1.3% of their average net earnings, while they amount to 1.1% for Domtar.

The potential financial impacts summarized in Table 4.3 and 4.4 relate to 29 plants in the industrial minerals sector which are operated by the 11 public corporations in the sector. The analyses refer to the consolidated financial performance of these 11 firms. Plant-specific profit and loss data are not available. Even taking into account the anticipated total incremental costs of monitoring for those firms with plants in other MISA sectors, there is no indication that monitoring costs will strain the financial capabilities of any of the firms for which financial data are available.

Although detailed financial information is not available, it is still possible to assess the impacts of anticipated costs of monitoring on some of the plants and industry categories that are not represented in Table 4.3 and 4.4. Table 4.5 provides a summary of the potential impacts of average costs of monitoring on selected performance indicators by commodity. This analysis makes use of the average performance statistics by commodity from Table 2.2.

Table 4.5 shows that the anticipated average operating cost of monitoring for plants in the Sand and Gravel category amounts to 9.4% of the estimate of average earnings from operations for this commodity. However, this figure is likely to be overstated because average earnings take into account both larger plants and a large number of small sand and gravel pits which would not be subject to MISA monitoring. Still, to the extent that the six plants face significant competition in their local markets, it is possible that monitoring costs could reduce after-tax profits by as much as 5% for the year.

Anticipated capital costs of monitoring in the Talc category amount to 3.2% of 1987 capital expenditures. Average anticipated operating costs of monitoring amount to 19.7% of average after-tax profits by talc producers in 1987. The latter figure is noteworthy and dictates that this industry category merits close scrutiny as the monitoring program gets under way, particularly in light of the current excess capacity for talc production which was noted above.

Because the plants in the Graphite category have not yet begun operating, no information is available to assess potential financial impacts of monitoring cost on these plants. However, it is not anticipated that the likely costs of monitoring will be a major financial burden for the two plants. The companies opening these plants are aware that environmental approval is necessary to

TABLE 4.5

SUMMARY OF IMPACTS OF AVERAGE COSTS OF MONITORING ON SELECTED 1987 PERFORMANCE INDICATORS BY COMMODITY

COMMODITY	Monitoring Capital Cost as a % of average 1987 Capital Expenditure	Monitoring Operating Cost as a % of average 1987 Operating Earnings (Loss)	Monitoring Operating Cost as a % of average 1987 After-Tax Profits (Loss)
CEMENT	n.a.	0.20%	n.a.
CHEMICAL LIME	n.a.	1.18%	n.a.
CLAY	n.a.	0.23%	n.a.
GRAPHITE	n.a.	n.a.	n.a.
GYPSUM	2.48%	-12.97%	20.73%
MAGNESIUM	n.a.	n.a.	n.a.
QUARRIES			
Stone	n.a.	0.24%	n.a.
Quartz	0.31%	0.22%	0.22%
SAND AND GRAVEL	n.a.	9.43%	n.a.
TALC	3.24%	191.77%	19.68%

NOTE: Average costs by industry category are related to average financial indicators by product category. The plants and firms for which financial indicators are calculated are not generally identical to those in the MISA industry category for which costs are determined.

SOURCE: Table 2.2 and Table 3.8.

begin operations and should have taken likely environmental costs into account when planning these facilities.

Among the industry categories for which firm specific information is available, the figures for gypsum stand out in Table 4.5. The average anticipated operating cost of monitoring amounts to 20.7% of average after-tax profits for gypsum plants in 1987. However, this figure may be somewhat misleading because gypsum production is vertically integrated with wallboard production. The potential impacts for GSC Inc., reported in Tables 4.3 and 4.4 will likely give a better indication of the potential impact on firms in this category. As was suggested earlier, it is also likely that wallboard prices will increase in response to the additional costs of monitoring in gypsum plants. Still, economic and financial conditions in this industry should be further scrutinized in light of the relatively high ratio of operating costs of monitoring to 1987 after-tax profits that was noted above.

4.5 Other Factors

Two further qualifications are noted regarding the impacts of the anticipated costs of monitoring on the industrial minerals sector.

First, the monitoring costs cited in this report constitute only a part of the environmental protection costs this and other industrial sectors will face in Ontario, and elsewhere for that matter. Estimates of total MISA costs have been provided for the four firms known to operate plants in other industrial sectors. Furthermore, many of the plants and firms in the industrial minerals sector will likely face additional costs of further abatement of water, air and solid waste pollutants as new requirements are put in place. Under MISA, effluent limits regulations will be promulgated for the various industrial sectors and for municipal sewage treatment plants. Regulations concerning air pollution control are being amended which could imply further costs for industrial plants (Ontario Ministry of the Environment, 1987b).

The cumulative costs of these environmental programs are not likely to be the sole financial burden imposed by government on firms in this sector. Additional costs may be imposed by regulatory requirements for workplace health and safety and for consumer protection which are administered by other provincial and federal government agencies.

Second, the analyses of impacts of potential costs of monitoring were based on economic conditions and financial information during the past six years. A significant downturn in the Ontario economy may substantially alter the impacts of monitoring costs on the plants and firms in the industrial minerals sector. The revenues for plants in many of the industry categories in the sector are closely linked to construction activity. The health of the automotive sector and the pulp and paper industry, in particular, will also affect purchases from some industry categories.

A number of economic forecasters feel that a slowdown of economic activity, if not an outright recession, is likely during 1990 (for example, The Globe and Mail, August 19, 1989; and the Royal Bank of Canada, October 17, 1989). A continuation of the high interest rate policy pursued by the Bank of Canada will compound the effect on the Ontario economy. Construction starts in Ontario have already fallen from the peak levels in recent years. Economic conditions in the United States and the rest of Canada will have at least an indirect impact on the markets in the industrial minerals sector. Consequently, subsequent analyses should note any significant change in economic activity in the U.S. and the rest of Canada, as well as in Ontario.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The MISA monitoring requirements for the industrial minerals sector provide for different testing schedules according to the type of effluent stream at each plant. For the most part, the different plants within each industry category must test like sampling points for the same compounds and at the same frequency.

Estimates of total operating and maintenance (O & M) costs of monitoring for the year by industry category range from $49,300 for the Magnesium category to $415,300 for the Quarries category. Anticipated capital costs range from $7,000 for the Magnesium category to $138,000 for the Quarries category.

The 94 plants in the Quarries category face the lowest average total cost of monitoring, at about $5,900 for the year per plant. The next lowest anticipated total cost per plant is faced by the Clay and Shale category, at $20,000 for the year, followed by the Sand and Gravel category, at $21,500 for the year. Most plants in these three categories will have to test three times per week. The expected difference in average cost for the Quarries category as compared to the next lowest cost categories results from the use of a representative sampling of 20 quarries, with the remaining quarries designated as non-monitoring sites but sharing the costs.

Plants in the Cement category face the highest average total cost of monitoring, at about $75,900 per plant for the year. Graphite plants face average total costs of $71,900 per plant for the year, while plants in the Gypsum category face average total costs of monitoring of $69,900 for the year. Most plants in these three industry categories are expected to have two sampling points, while most of the plants in the other industry categories are likely to have a single sampling point.

Total anticipated costs of monitoring for the industrial minerals sector amount to about $2.1 million for the year, of which O & M costs are likely to account for about $1.8 million. Analytical testing, which consists of characterization, routine analyses and toxicity testing, accounts for 49.4% of the expected O & M costs, while sampling activities account for 37.7%. Of $333,000 in expected capital costs of monitoring, $323,000 is for reporting and the remainder for flow measurement devices.

An allowance of plus or minus 20% in the cost estimates is suggested in order to account for uncertainties and contingencies in the estimation. The total cost of the MISA Monitoring Regulation for the industrial minerals sector is likely to be between $1.7 million and $2.5 million for the year based on the point estimate of $2.1 million.

In the event that all 94 plants in the Quarries category were required to undertake monitoring activities, rather than just the 20 representative sites, the total costs would increase by about $1.6 million for the year, or by about 75% of current point estimate for the sector. If plants with settling ponds in the Quarries and the Sand and Gravel categories were required to take three-grab or automatic composite samples rather than grab samples, total costs would increase by between $78,000 and $309,000 for the year. In contrast, total costs for the sector could be reduced by about $206,000 for the year if all plants in the sector were permitted to take grab samples, but the sampling data could be less reliable as a result.

An analytical procedure is employed to provide a reasonable indication of the maximum potential impacts of monitoring costs on average commodity prices in the sector. For various industry categories, estimates are computed of the total monitoring costs per unit of 1987 production of the commodity which corresponds to each category. Estimates, expressed as a percentage of average unit value during the 1980's, range from about 0.1% for magnesium and for sand and gravel to about 1.7% for gypsum and for talc.

Based on the market structure of the various industry categories, it is likely that most of the additional cost of monitoring could be passed on as price increases in the following categories: Cement, Chemical Lime, Clay and Shale, and Gypsum. On the other hand, plants in the Graphite, Magnesium, and Talc categories are unlikely to be able to pass along more than a small part of the monitoring costs as price increases. It is not possible to assess the likelihood that costs will be passed along as price increases by plants in the

Quarries and the Sand and Gravel categories because the necessary information concerning local market conditions is not available.

The potential financial impacts of the additional sector costs of monitoring are analyzed for 11 public corporations which operate 29 plants in the sector. Based on the averages during the period from 1983 through 1988, rates of return on capital employed would be reduced by no more than 0.07% even if all O & M costs of monitoring were paid out of profits. The estimated capital costs of monitoring amount to less than 0.2% of average annual capital expenditures by any of the firms during the period. Estimated sector operating costs of monitoring correspond to less than 0.5% of average net earnings during the period, except that for Timminco Limited, they amount to 2.5% of average net earnings.

Four of the 11 corporations (Dofasco Inc., Domtar Inc., Falconbridge Limited, and Stelco Inc.) operate plants in other sectors that are subject to MISA monitoring requirements. The estimated costs of monitoring for their plants in the other sectors are substantially higher than the costs within the industrial minerals sector. Nevertheless, taking into account the total operating costs of monitoring in all MISA sectors, the average rates of return on capital employed would be reduced by no more than 0.05% for any of the four firms. Estimates of total MISA capital costs of monitoring amount to 1.5% of Dofasco's average capital expenditures during the six year period and about half as much for the other three firms. The estimated total operating costs of monitoring for Stelco amount to 2.9% of its average net earnings during the six year period but to less than half of the percentage for the other three firms.

The potential impacts of average costs of monitoring on selected performance indicators are also analyzed by commodity based on information from the Annual Census of Mines, Quarries and Sand Pits, 1987. For plants which produce gypsum and talc, estimated O & M costs of monitoring amount to about 20% of the average estimated after-tax profits during the 1980's. This indicator is of special concern for plants in the Talc category. Gypsum and wallboard prices could potentially be increased in response to costs of monitoring, but talc firms are not likely to be able to raise their product prices to any great degree so as to offset the monitoring costs.

There is no indication that the financial capabilities of any firm in the sector will be significantly burdened, based on the financial analyses highlighted above.

The analyses and data presented in this report provide benchmarks for the assessments of future environmental protection costs which may be incurred by this sector. The cumulative cost burdens of future environmental protection requirements and other regulatory agenda (e.g., workplace health and safety) are likely to grow.

The analyses of the financial impacts discussed in this report are based on current economic conditions. Significant deterioration in economic conditions, particularly in the construction sector, and for the iron and steel and the pulp and paper industries, will adversely affect the financial outlock of firms in the industrial minerals sector.

5.2 Recommendations

In order to identify possible problems at an early stage, it is recommended that the Ministry of the Environment and the various firms and industry organizations in the sector work together to identify the actual costs of the monitoring requirements in the early portion of the regulation period. Early identification of possible financial burdens will enable this Ministry and the individual plant to review and assess workable solutions.

Also, at the end of the regulation period, it is recommended that each plant report the actual incremental costs incurred due to the MISA monitoring requirements in order to:

- validate and improve the cost-estimation procedures used in this report; and
- monitor and assess the financial and employment impacts of the monitoring requirements.

The cumulative financial burdens of monitoring requirements in other sectors, other MISA requirements, air and solid waste control regulations and regulatory requirements by other federal and provincial agencies should be monitored.

Finally, when monitoring data and activities at these plants (and other industrial dischargers) are audited by Ministry of the Environment personnel or their agents, information should be gathered to determine whether the monitoring activities or data have been, or could be, helpful in making the operations or processes more efficient and productive.

REFERENCES

Brampton Brick Limited (Annual). Annual Report.

CGC Inc. (Annual). Annual Report.

M.M. Dillon (1988). Inventory and Critical Review of Laboratory Resources. Prepared for Laboratory Services Branch, Ontario Ministry of the Environment.

Dofasco Inc. (Annual). Annual Report.

Domtar Inc. (Annual). Annual Report.

Energy, Mines and Resources Canada (1988). Canadian Minerals Yearbook: 1987 Review and Outlook.

Energy, Mines and Resources Canada (1989). Canadian Minerals Yearbook: 1988 Review and Outlook.

Energy, Mines and Resources Canada and Ontario Ministry of Northern Development and Mines (1989). Annual Census of Mines, Quarries and Sand Pits, 1988.

Falconbridge Limited (Annual). Annual Report.

The Financial Post Company Limited. The Financial Post Information Service.

Government of Ontario (1988). "Regulation Made Under the Environmental Protection Act, Effluent Monitoring - General" (Ontario Regulation 695/88).

The Globe and Mail (August 19, 1989). "Economic growth likely to fizzle this year and next, group says," in Report on Business, page B4.

Guillet, G.R. and I.H. Joyce (1987). The Clay and Shale Industries of Ontario. Toronto: Ontario Ministry of Natural Resources.

Jannock Limited (Annual). Annual Report.

Knapp, R.A. (April 26, 1989), SENES Consultants Limited. Memorandum to K. Donyina, MISA Industrial Section, on behalf of the Aggregate Producers Association of Ontario.

Lafarge Canada Inc. (Annual). Annual Report.

Lafarge Corporation (Annual). Annual Report.

Minnesota Mining and Manufacturing Company (Annual). 3M Annual Report.

Ontario Ministry of the Environment (1986). Municipal-Industrial Strategy for Abatement (MISA): A Policy and Program Statement of the Government of Ontario on Controlling Municipal and Industrial Discharges into Surface Waters.

Ontario Ministry of the Environment (1987a). Economic Information Needs and Assessments for Development MISA Monitoring and Abatement Requirements.

Ontario Ministry of the Environment (1987b). Stopping Air Pollution at its Source - CAP - Clean Air Program. Discussion Paper.

Ontario Ministry of the Environment (1988). Controlling Industrial Discharges to Sewers.

Ontario Ministry of the Environment (1989a). The Development Document for the Draft Effluent Monitoring Regulationfor the Ontario Mineral Industry: Group "B" - Industrial Minerals Sector.

Ontario Ministry of the Environment (1989b). An Economic and Financial Profile of the Ontario Mineral Industry: Group "B" - Industrial Minerals Sector. Policy and Planning Branch. (Forthcoming)

Ontario Ministry of the Environment (1989c). Ontario's Organic Chemical Manufacturing Sector - Monitoring Cost Estimates. Policy and Planning Branch.

Ontario Ministry of the Environment (1989d). Economic Implications of the MISA Monitoring Regulations on Ontario's Iron and Steel Sector. Policy and Planning Branch.

Ontario Ministry of the Environment (1989e). Monitoring Costs and Their Implications for Direct Dischargers in the Ontario Pulp and Paper Industry. Policy and Planning Branch.

Ontario Ministry of the Environment (1989f). Monitoring Costs and Their Implications for Direct Dischargers in the Ontario Mineral Group "A" Sector. Policy and Planning Branch.

Ontario Ministry of the Environment (1989g). Monitoring Costs and Their Implications for Direct Dischargers in the Ontario Metal Casting Industry. Policy and Planning Branch.

Ontario Ministry of Natural Resources (1982). Ontario Industrial Minerals. Industrial Mineral Background Paper 2. D. Geoffry Minnes, Industrial Minerals Section.

Ontario Ministry of Natural Resources (1989). Lime Industries of Ontario, Volume 1.

Ontario Ministry of Northern Development and Mines (1988) Ontario Mineral Score: 1987.

Ontario Ministry of Northern Development and Mines (1989) Ontario Mineral Score: 1988.

Ontario Ministry of Treasury and Economics, (1989a). Ontario Economic Accounts: May 1989.

Ontario Ministry of Treasury and Economics, (1989b). Economic Conditions, various issues. Office of Economic Policy.

Portland Cement Association (Annual). U.S. and Canadian Portland Cement Industry: Plant Information Summary. PCA Market and Economic Research Group. Skokie, Illinois.

The Royal Bank of Canada (October 17, 1989). "Economy can avoid recession but risks high," in Econoscope.

St. Lawrence Cement Inc. (Annual). Annual Report.

Stelco Inc. (Annual). Annual Report.

3M Canada Inc. (Annual). Annual Report for Employees.

Timminco Limited (Annual). Annual Report.

COSTS BY PLANT FOR THE INDUSTRIAL MINERALS SECTOR

The following tables provide estimates of the incremental costs of the MISA monitoring regulation by plant and industry category for the individual minerals sector:

Table A.1:	Annual Operating and Maintenance Costs of Sampling
Table A.2:	Annual Operating Costs for Chemical Analysis
Table A.3:	Annual Operating Costs of Toxicity Testing
Table A.4:	Flow Measurement and Reporting Costs for the Year
Table A.5:	Total Estimated Costs Relating to the Monitoring Regulation

Tables A.1 through A.4 present the costs by analytical function at each plant in the sector. Table A.5 summarizes the expected costs to be incurred by each plant as a result of the Regulation. The anticipated costs to be incurred by most plants in the Quarries category are based on the cost sharing arrangement provided for in the Regulation. For plants in the other industry categories, the costs indicated in Table A.5 represent the summation of costs from the previous four tables.

As discussed in Chapter 3, it is assumed that all initial toxicity tests will be passed so that the minimum number of toxicity tests will be carried out by all plants in the sector. This assumption is reflected in the total cost estimates. In the event that toxicity tests are failed, the plants are likely to incur higher costs than indicated in the totals in Table A.5.

The plant numbers in these tables are identical to those in Table 1.2 and correspond to the item numbers in Part C - Schedule A of the Development Document (Ontario Ministry of the Environment, 1989a). The notes in Table 1.2 indicate the corporate relationships between the plants and firms in this sector.

TABLE A.1: ANNUAL OPERATING AND MAINTENANCE COSTS OF SAMPLING (IN $1,000's)

Plant	Routine Analyses			Characterization/Toxicity		TOTAL [*]
	Collect/Prep	Coolers	Transport	Min.	Max.	
CEMENT CATEGORY						
1. LaFarge Canada Inc. - Bath	$18.7	$0.1	$9.4	$1.5	$4.0	$29.7
2. LaFarge Canada Inc. - Woodstock	18.7	0.1	9.4	1.5	4.0	29.7
3. Lake Ontario Cement	18.7	0.1	9.4	1.5	4.0	29.7
4. St. Lawrence Cement	14.0	0.1	6.2	1.5	4.0	21.9
5. St. Marys Cement Company - Bowmanville	18.7	0.1	9.4	1.5	4.0	29.7
6. St. Marys Cement Company - St. Marys	18.7	0.1	9.4	1.5	4.0	29.7
SUBTOTAL	$107.6	$0.6	$53.0	$9.0	$24.0	$170.3
CHEMICAL LIME CATEGORY						
7. BeachviLime Limited (East Plant)	$14.0	$0.1	$6.2	$1.5	$4.0	$21.9
8. BeachviLime Limited (West Plant)	14.0	0.1	6.2	1.5	4.0	21.9
9. Guelph DoLime Limited	14.0	0.1	6.2	1.5	4.0	21.9
10. Reiss Lime Co. of Canada Ltd.	14.0	0.1	6.2	1.5	4.0	21.9
11. Steetley Quarry Products Inc.	14.0	0.1	6.2	1.5	4.0	21.9
12. Stelco Chemical Lime Works	14.0	0.1	6.2	1.5	4.0	21.9
SUBTOTAL	$84.2	$0.6	$37.4	$9.0	$24.0	$131.3
CLAY AND SHALE CATEGORY						
13. Brampton Brick Ltd.	$0.4	$0.1	$0.6	$1.5	$4.0	$2.6
14. Canada Brick Company - Burlington	0.4	0.1	0.6	1.5	4.0	2.6
15. Canada Brick Company - Cooksville	0.4	0.1	0.6	1.5	4.0	2.6
16. Canada Brick Company - Gloucester	0.4	0.1	0.6	1.5	4.0	2.6
17. Canada Brick Company - Streetsville	0.4	0.1	0.6	1.5	4.0	2.6
SUBTOTAL	$1.8	$0.5	$3.1	$7.5	$20.0	$12.9
GRAPHITE CATEGORY						
18. Cal Graphite Corporation	$14.4	$0.1	$6.9	$1.5	$4.0	$22.9
19. North Coast Industries Ltd.	18.7	0.1	9.4	1.5	4.0	29.7
SUBTOTAL	$33.1	$0.2	$16.2	$3.0	$8.0	$52.5
GYPSUM CATEGORY						
20. CGC Limited	$18.7	$0.1	$9.4	$1.5	$4.0	$29.7
21. Domtar Construction Materials	18.7	0.1	9.4	1.5	4.0	29.7
22. Westroc Industries Limited	14.0	0.1	6.2	1.5	4.0	21.9
SUBTOTAL	$51.5	$0.3	$25.0	$4.5	$12.0	$81.2
MAGNESIUM CATEGORY						
23. Timminco Ltd.	$14.4	$0.1	$6.9	$1.5	$4.0	$22.9

(...Continued)

TABLE A.1 (Continued)

Plant	Routine Analyses			Characterization/Toxicity		TOTAL [*]
	Collect/Prep	Coolers	Transport	Min.	Max.	
QUARRIES CATEGORY						
24. Amherst Quarries (1969) Ltd.	$1.6	$0.1	$2.5	$0.5	$2.0	$4.7
25. B&M Carriers Ltd. - N. Plantagenet						
26. B&M Carriers Ltd. - S. Plantagenet						
27. Beaver Road Builders Ltd.						
28. Bertrand & Frere - L'Original						
29. Bertrand & Frere - Longueil						
30. Bertrand & Frere - S. Plantagenet						
31. Thomas Cavanagh Construction Ltd.						
32. Cayuga Materials & Construction Co.						
33. Cedarhurst Quarries & Crushing Ltd.						
34. Allan G. Cook Limited	1.6	0.1	2.5	0.5	2.0	4.7
35. Cornwall Gravel Co. - Cornwall	1.6	0.1	2.5	0.5	2.0	4.7
36. Cornwall Gravel Co. - Clarence	1.6	0.1	2.5	0.5	2.0	4.7
37. Cornwall Gravel Co. - Winchester						
38. Cruickshank Construction - Amherstview						
39. Cruickshank Construction - Kingston	1.6	0.1	2.5	0.5	2.0	4.7
40. Cruickshank Construction - Green Valley						
41. Cruickshank Construction - Lancaster						
42. Cruickshank Construction - Williamsburg						
43. Cruickshank Construction - Kenyon Twp.						
44. Dechan Const. Ltd.						
45. James Dick Construction Ltd.						
46. George W. Drummond Ltd.						
47. Dufferin Aggregates - Milton	1.6	0.1	2.5	0.5	2.0	4.7
48. Dunnville Rock Products Ltd.						
49. Dymond Clay Products Ltd.						
50. Flamboro Quarries Ltd.,	1.6	0.1	2.5	0.5	2.0	4.7
51. Fowler Construction Company Ltd.						
52. Francon Div. of Lafarge Canada Inc.	1.6	0.1	2.5	0.5	2.0	4.7
53. Gormley Aggregates Ltd. - Buckhorn						
54. Gormley Aggregates Ltd. - Carden Twp.	1.6	0.1	2.5	0.5	2.0	4.7
55. Griffin Brothers - Battersea Quarry						
56. Griffin Brothers - Joyceville Quarry						
57. Griffin Brothers - Lynns Quarry						
58. Halton Crushed Stone Ltd.						
59. Hard Rock Paving Co. Ltd.	1.6	0.1	2.5	0.5	2.0	4.7
60. Indusmin - Blue Mountain	1.6	0.1	2.5	0.5	2.0	4.7
61. Indusmin - Nephton						
62. Indusmin - Badgeley Island						
63. Karson Kartage & Konstruction Co.						

(...Continued)

TABLE A.1 (Continued)

Plant	Routine Analyses			Characterization/Toxicity		TOTAL [*]
	Collect/Prep	Coolers	Transport	Min.	Max.	
QUARRIES CATEGORY (Continued)						
104. R.W. Tomlinson Ltd.	$1.6	$0.1	$2.5	$0.5	$2.0	$4.7
105. United Aggregates Ltd. - Acton						
106. United Aggregates Ltd. - Gloucester						
107. Walker Industries - Ridgemont Quarries	1.6	0.1	2.5	0.5	2.0	4.7
108. Walker Industries - Vineland Quarries						
109. Walker Industries - Walker Bros.						
110. Warren Paving & Materials - Cornwall						
111. Warren Paving & Materials - Kingston						
112. Warren Paving & Materials - Gloucester	1.6	0.1	2.5	0.5	2.0	4.7
113. Warren Paving & Materials - Nepean						
114. Warren Paving & Materials - Montague						
115. Warren Paving & Materials - Stittsville						
116. Waterford Sand & Gravel Ltd.						
117. Woods's Sand and Gravel Ltd.	14.0	0.1	6.2	0.5	2.0	20.9
SUBTOTAL	$57.7	$2.0	$58.7	$11.0	$40.5	$129.4
SAND AND GRAVEL CATEGORY						
118. Frank Kling Ltd.	$1.6	$0.1	$2.5	$0.5	$2.0	$4.7
119. Kam Aggregates Limited	1.6	0.1	2.5	0.5	2.0	4.7
120. Lempiala Sand & Gravel Ltd.	1.6	0.1	2.5	0.5	2.0	4.7
121. Oxford Sand and Gravel Ltd.	1.6	0.1	2.5	0.5	2.0	4.7
122. Seeley & Arnill Aggregates Ltd.	1.6	0.1	2.5	0.5	2.0	4.7
123. Standard Aggregates, Inc. - Guelph	1.6	0.1	2.5	0.5	2.0	4.7
SUBTOTAL	$9.4	$0.6	$15.0	$3.0	$12.0	$27.9
TALC CATEGORY						
124. Canada Talc Ltd.	$14.0	$0.1	$6.2	$1.5	$4.0	$21.9
125. Luzenac Inc.	14.0	0.1	6.2	1.5	4.0	21.9
SUBTOTAL	$28.1	$0.2	$12.5	$3.0	$8.0	$43.8
SECTOR TOTALS	$387.8	$5.1	$227.8	$51.5	$152.5	$672.2

NOTE: "Collect/Prep" refers to the labour costs involved with the collection and preparation of samples for testing. "Coolers" refers to the costs of portable coolers for refrigerated storage. "Transport" includes the costs of sample containers, packing materials and courier fees. See Section 2.2 for discussion of the procedures used for the determination of sampling costs.

[*] It is assumed that minimum costs for characterization and toxicity sampling will apply.

SOURCES: Ontario Ministry of the Environment (1989a), the MISA Office and Table 2.2

TABLE A.1 (Continued)

Plant	Routine Analyses			Characterization/Toxicity		TOTAL [*]
	Collect/Prep	Coolers	Transport	Min.	Max.	
QUARRIES CATEGORY (Continued)						
64. George Kennedy						
65. E.C. King Contracting						
66. M.J. Labelle Company Ltd.						
67. Markham Sand & Gravel - Brechin						
68. Markham Sand & Gravel - Sophiasburg Twp.						
69. H.J. McFarland Const. - Clarence Twp.						
70. H.J. McFarland Const. - Nepean						
71. H.J. McFarland Const. - Tyendinaga						
72. McKendry Quarries - Glen Quarry						
73. McKendry Quarries - Westbrook Quarry						
74. Milton Limestone	$1.6	$0.1	$2.5	$0.5	$2.0	$4.7
75. Nelson Aggregate Company - Beamsville						
76. Nelson Aggregate Company - Burlington	1.6	0.1	2.5	0.5	2.0	4.7
77. Nelson Aggregate Company - Uhthoff	1.6	0.1	2.5	0.5	2.0	4.7
78. Nelson Granite						
79. Norfolk Quarries Company						
80. Permanent Concrete - Brockville Quarry						
81. Permanent Concrete - Cornwall Quarry	1.6	0.1	2.5	0.5	2.0	4.7
82. Permanent Concrete - Hawthorne Quarry						
83. Permanent Concrete - Navan Quarry						
84. Permanent Concrete - Orleans Quarry						
85. Permanent Concrete - Selby Quarry						
86. Permanent Concrete - Violet Road Quarry						
87. Port Colborne Quarries Ltd.						
88. Seeley & Arnill Aggregates Ltd.						
89. Smiths Construction Co. Arnprior Ltd.						
90. Spratt Sand & Gravel Ltd.						
91. St. Lawrence Cement Inc.						
92. Standard Aggregates Inc. - Brechin						
93. Standard Aggregates Inc. - Gore Bay						
94. Standard Aggregates Inc. - Hagersville						
95. Steeprock Calcite						
96. Steetley Quarry Products - Flamborough						
97. Steetley Quarry Products - Niagara Falls						
98. G. Tackaberry & Sons - Elizabethtown						
99. G. Tackaberry & Sons - Lowson Quarry						
100. G. Tackaberry & Sons - Willows Quarry						
101. G. Tackaberry & Sons - Jasper Quarry						
102. Taro Aggregates Limited						
103. 3M Canada Ltd.	15.6	0.1	7.5	1.5	2.5	24.7

(...Continued)

TABLE A.2: ANNUAL OPERATING COSTS FOR CHEMICAL ANALYSIS (IN $1,000's)

Plant	Routine Analyses				Character-ization Analyses	TOTAL COST OF CHEMICAL ANALYSES [*]
	3/Week	Weekly	Monthly	TOTAL		
CEMENT CATEGORY						
1. LaFarge Canada Inc. - Bath	$18.7	n.a.	$3.2	$21.9	$12.8	$34.7
2. LaFarge Canada Inc. - Woodstock	18.7	n.a.	3.2	21.9	12.8	34.7
3. Lake Ontario Cement	18.7	n.a.	3.2	21.9	12.8	34.7
4. St. Lawrence Cement	9.7	n.a.	1.5	11.2	6.9	18.1
5. St. Marys Cement Company - Bowmanville	18.7	n.a.	3.2	21.9	12.8	34.7
6. St. Marys Cement Company - St. Marys	18.7	n.a.	3.2	21.9	12.8	34.7
SUBTOTAL	$103.2		$17.3	$120.5	$71.2	$191.6
CHEMICAL LIME CATEGORY						
7. BeachviLime Limited (East Plant)	$9.7	n.a.	$0.4	$10.1	$7.0	$17.1
8. BeachviLime Limited (West Plant)	9.7	n.a.	0.4	10.1	7.0	17.1
9. Guelph DoLime Limited	9.7	n.a.	0.4	10.1	7.0	17.1
10. Reiss Lime Co. of Canada Ltd.	9.7	n.a.	8.2	17.9	5.9	23.8
11. Steetley Quarry Products Inc.	9.7	n.a.	0.4	10.1	7.0	17.1
12. Stelco Chemical Lime Works	9.7	n.a.	0.4	10.1	7.0	17.1
SUBTOTAL	$58.2		$10.2	$68.4	$40.9	$109.3
CLAY AND SHALE CATEGORY						
13. Brampton Brick Ltd.	n.a.	n.a.	$2.2	$2.2	$6.9	$9.1
14. Canada Brick Company - Burlington	n.a.	n.a.	2.2	2.2	6.9	9.1
15. Canada Brick Company - Cooksville	n.a.	n.a.	2.2	2.2	6.9	9.1
16. Canada Brick Company - Gloucester	n.a.	n.a.	2.2	2.2	6.9	9.1
17. Canada Brick Company - Streetsville	n.a.	n.a.	2.2	2.2	6.9	9.1
SUBTOTAL			$10.9	$10.9	$34.5	$45.4
GRAPHITE CATEGORY						
18. Cal Graphite Corporation	$9.7	n.a.	$7.2	$16.9	$6.7	$23.6
19. North Coast Industries Ltd.	18.7	n.a.	6.0	24.7	12.7	37.3
SUBTOTAL	$28.4		$13.2	$41.6	$19.4	$61.0
GYPSUM CATEGORY						
20. CGC Limited	$18.7	n.a.	$1.6	$20.3	$13.0	$33.3
21. Domtar Construction Materials	18.7	n.a.	1.6	20.3	13.0	33.3
22. Westroc Industries Limited	9.7	n.a.	1.1	10.8	7.0	17.8
SUBTOTAL	$47.1		$4.3	$51.4	$33.0	$84.4
MAGNESIUM CATEGORY						
23. Timminco Ltd.	$9.7	n.a.	$3.0	$12.7	$6.9	$19.6

(...Continued)

TABLE A.2 (Continued)

Plant	Routine Analyses				Character-ization Analyses	TOTAL COST OF CHEMICAL ANALYSES [*]
	3/Week	Weekly	Monthly	TOTAL		
QUARRIES CATEGORY						
24. Amherst Quarries (1969) Ltd.	n.a.	$3.7	$1.1	$4.8	$4.6	$9.4
25. B&M Carriers Ltd. - N. Plantagenet						
26. B&M Carriers Ltd. - S. Plantagenet						
27. Beaver Road Builders Ltd.						
28. Bertrand & Frere - L'Original						
29. Bertrand & Frere - Longueil						
30. Bertrand & Frere - S. Plantagenet						
31. Thomas Cavanagh Construction Ltd.						
32. Cayuga Materials & Construction Co.						
33. Cedarhurst Quarries & Crushing Ltd.						
34. Allan G. Cook Limited	n.a.	3.7	1.1	4.8	4.6	9.4
35. Cornwall Gravel Co. - Cornwall	n.a.	3.7	1.1	4.8	4.6	9.4
36. Cornwall Gravel Co. - Clarence	n.a.	3.7	1.1	4.8	4.6	9.4
37. Cornwall Gravel Co. - Winchester						
38. Cruickshank Construction - Amherstview						
39. Cruickshank Construction - Kingston	n.a.	3.7	1.1	4.8	4.6	9.4
40. Cruickshank Construction - Green Valley						
41. Cruickshank Construction - Lancaster						
42. Cruickshank Construction - Williamsburg						
43. Cruickshank Construction - Kenyon Twp.						
44. Dechan Const. Ltd.						
45. James Dick Construction Ltd.						
46. George W. Drummond Ltd.						
47. Dufferin Aggregates - Milton	n.a.	3.7	0.7	4.4	4.6	9.0
48. Dunnville Rock Products Ltd.						
49. Dymond Clay Products Ltd.						
50. Flamboro Quarries Ltd.	n.a.	3.7	0.7	4.4	4.6	9.0
51. Fowler Construction Company Ltd.						
52. Francon Div. of Lafarge Canada Inc.	n.a.	3.7	1.1	4.8	4.6	9.4
53. Gormley Aggregates Ltd. - Buckhorn						
54. Gormley Aggregates Ltd. - Carden Twp.	n.a.	3.7	1.1	4.8	4.6	9.4
55. Griffin Brothers - Battersea Quarry						
56. Griffin Brothers - Joyceville Quarry						
57. Griffin Brothers - Lynne Quarry						
58. Halton Crushed Stone Ltd.						
59. Hard Rock Paving Co. Ltd.	n.a.	3.7	1.1	4.8	4.6	9.4
60. Indusmin - Blue Mountain	n.a.	3.7	0.7	4.4	4.6	9.0
61. Indusmin - Nephton						
62. Indusmin - Badgeley Island						
63. Karson Kartage & Konstruction Co.						

(...Continued)

TABLE A.2 (Continued)

Plant	Routine Analyses				Character-ization Analyses	TOTAL COST OF CHEMICAL ANALYSES [*]
	3/Week	Weekly	Monthly	TOTAL		
QUARRIES CATEGORY (Continued)						
64. George Kennedy						
65. E.C. King Contracting						
66. M.J. Labelle Company Ltd.						
67. Markham Sand & Gravel - Brechin						
68. Markham Sand & Gravel - Sophiasburg Twp.						
69. H.J. McFarland Const. - Clarence Twp.						
70. H.J. McFarland Const. - Nepean						
71. H.J. McFarland Const. - Tyendinaga						
72. McKendry Quarries - Glen Quarry						
73. McKendry Quarries - Westbrook Quarry						
74. Milton Limestone	n.a.	$3.7	$1.1	$4.8	$4.6	$9.4
75. Nelson Aggregate Company - Beamsville						
76. Nelson Aggregate Company - Burlington	n.a.	3.7	1.1	4.8	4.6	9.4
77. Nelson Aggregate Company - Uhthoff	n.a.	3.7	1.1	4.8	4.6	9.4
78. Nelson Granite						
79. Norfolk Quarries Company						
80. Permanent Concrete - Brockville Quarry						
81. Permanent Concrete - Cornwall Quarry	n.a.	3.7	1.1	4.8	4.6	9.4
82. Permanent Concrete - Hawthorne Quarry						
83. Permanent Concrete - Navan Quarry						
84. Permanent Concrete - Orleans Quarry						
85. Permanent Concrete - Selby Quarry						
86. Permanent Concrete - Violet Road Quarry						
87. Port Colborne Quarries Ltd.						
88. Seeley & Arnill Aggregates Ltd.						
89. Smiths Construction Co. Arnprior Ltd.						
90. Spratt Sand & Gravel Ltd.						
91. St. Lawrence Cement Inc.						
92. Standard Aggregates Inc. - Brechin						
93. Standard Aggregates Inc. - Gore Bay						
94. Standard Aggregates Inc. - Hagersville						
95. Steeprock Calcite						
96. Steetley Quarry Products - Flamborough						
97. Steetley Quarry Products - Niagara Falls						
98. G. Tackaberry & Sons - Elizabethtown						
99. G. Tackaberry & Sons - Lowson Quarry						
100. G. Tackaberry & Sons - Willows Quarry						
101. G. Tackaberry & Sons - Jasper Quarry						
102. Taro Aggregates Limited						
103. 3M Canada Ltd.	19.4	0.0	4.4	23.8	13.7	37.5

(...Continued)

TABLE A.2 (Continued)

Plant	Routine Analyses				Characterization Analyses	TOTAL ANALYTICAL COSTS [*]
	3/Week	Weekly	Monthly	TOTAL		
QUARRIES CATEGORY (Continued)						
104. R.W. Tomlinson Ltd.	n.a.	$3.7	$1.1	$4.8	$4.6	$9.4
105. United Aggregates Ltd. - Acton						
106. United Aggregates Ltd. - Gloucester						
107. Walker Industries - Ridgemont Quarries	n.a.	3.7	1.1	4.8	4.6	9.4
108. Walker Industries - Vineland Quarries						
109. Walker Industries - Walker Bros.						
110. Warren Paving & Materials - Cornwall						
111. Warren Paving & Materials - Kingston						
112. Warren Paving & Materials - Gloucester	n.a.	3.7	1.1	4.8	4.6	9.4
113. Warren Paving & Materials - Nepean						
114. Warren Paving & Materials - Montague						
115. Warren Paving & Materials - Stittsville						
116. Waterford Sand & Gravel Ltd.						
117. Woods's Sand and Gravel Ltd.	9.7	n.a.	1.1	10.8	4.6	15.4
SUBTOTAL	$29.1	$66.5	$24.0	$119.5	$101.5	$221.1
SAND AND GRAVEL CATEGORY						
118. Frank Kling Ltd.	n.a.	$3.7	$0.7	$4.4	$4.5	$8.9
119. Kam Aggregates Limited	n.a.	3.7	0.7	4.4	4.5	8.9
120. Lempiala Sand & Gravel Ltd.	n.a.	3.7	0.7	4.4	4.5	8.9
121. Oxford Sand and Gravel Ltd.	n.a.	3.7	0.7	4.4	4.5	8.9
122. Seeley & Arnill Aggregates Ltd.	n.a.	3.7	0.7	4.4	4.5	8.9
123. Standard Aggregates, Inc. - Guelph	n.a.	3.7	0.7	4.4	4.5	8.9
SUBTOTAL		$22.2	$4.1	$26.3	$27.0	$53.3
TALC CATEGORY						
124. Canada Talc Ltd.	$9.7	n.a.	$2.4	$12.1	$7.0	$19.1
125. Luzenac Inc.	9.7	n.a.	2.4	12.1	7.0	19.1
SUBTOTAL	$19.4		$4.9	$24.2	$14.0	$38.2
SECTOR TOTALS	$295.0	$88.6	$91.9	$475.6	$348.3	$823.9

NOTE: Weekly rather than thrice weekly testing is allowed only for those plants in the Quarries and Sand & Gravel categories which use a settling pond. Current information indicates that settling ponds are in use at all effluent streams to be monitored in these catagories with the exception of wash water effluent at the 3M plant. Only monthly testing is required for storm water streams. The use of "n.a." indicates that the testing frequency does not apply to the plant in question.

[*] It is assumed that minimum costs for characterization and toxicity sampling will apply.

TABLE A.3: ANNUAL OPERATING COSTS OF TOXICITY TESTING

Plant	Number of Tests		Annual Cost ($1000's)	
	Min.	Max.	Min.	Max.
CEMENT CATEGORY				
1. LaFarge Canada Inc. - Bath	4	16	$2.4	$9.6
2. LaFarge Canada Inc. - Woodstock	4	16	2.4	9.6
3. Lake Ontario Cement	4	16	2.4	9.6
4. St. Lawrence Cement	2	8	1.2	4.8
5. St. Marys Cement Company - Bowmanville	4	16	2.4	9.6
6. St. Marys Cement Company - St. Marys	4	16	2.4	9.6
SUBTOTAL			$13.2	$52.8
CHEMICAL LIME CATEGORY				
7. BeachviLime Limited (East Plant)	2	8	$1.2	$4.8
8. BeachviLime Limited (West Plant)	2	8	1.2	4.8
9. Guelph DoLime Limited	2	8	1.2	4.8
10. Reiss Lime Co. of Canada Ltd.	2	8	1.2	4.8
11. Steetley Quarry Products Inc.	2	8	1.2	4.8
12. Stelco Chemical Lime Works	2	8	1.2	4.8
SUBTOTAL			$7.2	$28.8
CLAY AND SHALE CATEGORY				
13. Brampton Brick Ltd.	2	8	$1.2	$4.8
14. Canada Brick Company - Burlington	2	8	1.2	4.8
15. Canada Brick Company - Cooksville	2	8	1.2	4.8
16. Canada Brick Company - Gloucester	2	8	1.2	4.8
17. Canada Brick Company - Streetsville	2	8	1.2	4.8
SUBTOTAL			$6.0	$24.0
GRAPHITE CATEGORY				
18. Cal Graphite Corporation	2	8	$1.2	$4.8
19. North Coast Industries Ltd.	4	16	2.4	9.6
SUBTOTAL			$3.6	$14.4
GYPSUM CATEGORY				
20. CGC Limited	4	16	$2.4	$9.6
21. Domtar Construction Materials	4	16	2.4	9.6
22. Westroc Industries Limited	2	8	1.2	4.8
SUBTOTAL			$6.0	$24.0
MAGNESIUM CATEGORY				
23. Timminco Ltd.	2	8	$1.2	$4.8
QUARRIES CATEGORY				
24. Amherst Quarries (1969) Ltd.	1	4	$0.6	$2.4
25. B&M Carriers Ltd. - N. Plantagenet				
26. B&M Carriers Ltd. - S. Plantagenet				
27. Beaver Road Builders Ltd.				
28. Bertrand & Frere - L'Original				
29. Bertrand & Frere - Longueil				
30. Bertrand & Frere - S. Plantagenet				
31. Thomas Cavanagh Construction Ltd.				
32. Cayuga Materials & Construction Co.				
33. Cedarhurst Quarries & Crushing Ltd.				

(...Continued)

TABLE A.3 (Continued)

Plant	Number of Tests		Annual Cost ($1000's)	
	Min.	Max.	Min.	Max.
QUARRIES CATEGORY (Continued)				
34. Allan G. Cook Limited	1	4	$0.6	$2.4
35. Cornwall Gravel Co. - Cornwall	1	4	0.6	2.4
36. Cornwall Gravel Co. - Clarence	1	4	0.6	2.4
37. Cornwall Gravel Co. - Winchester				
38. Cruickshank Construction - Amherstview				
39. Cruickshank Construction - Kingston	1	4	0.6	2.4
40. Cruickshank Construction - Green Valley				
41. Cruickshank Construction - Lancaster				
42. Cruickshank Construction - Williamsburg				
43. Cruickshank Construction - Kenyon Twp.				
44. Dechan Const. Ltd.				
45. James Dick Construction Ltd.				
46. George W. Drummond Ltd.				
47. Dufferin Aggregates - Milton	1	4	0.6	2.4
48. Dunnville Rock Products Ltd.				
49. Dymond Clay Products Ltd.				
50. Flamboro Quarries Ltd.,	1	4	0.6	2.4
51. Fowler Construction Company Ltd.				
52. Francon Div. of Lafarge Canada Inc.	1	4	0.6	2.4
53. Gormley Aggregates Ltd. - Buckhorn				
54. Gormley Aggregates Ltd. - Carden Twp.	1	4	0.6	2.4
55. Griffin Brothers - Battersea Quarry				
56. Griffin Brothers - Joyceville Quarry				
57. Griffin Brothers - Lynns Quarry				
58. Halton Crushed Stone Ltd.				
59. Hard Rock Paving Co. Ltd.	1	4	0.6	2.4
60. Indusmin - Blue Mountain	1	4	0.6	2.4
61. Indusmin - Nephton				
62. Indusmin - Badgeley Island				
63. Karson Kartage & Konstruction Co.				
64. George Kennedy				
65. E.C. King Contracting				
66. M.J. Labelle Company Ltd.				
67. Markham Sand & Gravel - Brechin				
68. Markham Sand & Gravel - Sophiasburg Twp.				
69. H.J. McFarland Const. - Clarence Twp.				
70. H.J. McFarland Const. - Nepean				
71. H.J. McFarland Const. - Tyendinaga				
72. McKendry Quarries - Glen Quarry				
73. McKendry Quarries - Westbrook Quarry				
74. Milton Limestone	1	4	0.6	2.4
75. Nelson Aggregate Co. - Lincoln Quarry				
76. Nelson Aggregate Co. - Nelson Quarry	1	4	0.6	2.4
77. Nelson Aggregate Co. - Uhthoff Quarry	1	4	0.6	2.4
78. Nelson Granite				
79. Norfolk Quarries Company				
80. Permanent Concrete - Brockville Quarry				
81. Permanent Concrete - Cornwall Quarry	1	4	0.6	2.4
82. Permanent Concrete - Hawthorne Quarry				
83. Permanent Concrete - Navan Quarry				
84. Permanent Concrete - Orleans Quarry				
85. Permanent Concrete - Selby Quarry				
86. Permanent Concrete - Violet Road Quarry				
87. Port Colborne Quarries Ltd.				
88. Seeley & Arnill Aggregates Ltd.				
89. Smiths Construction Co. Arnprior Ltd.				

(...Continued)

TABLE A.3 (Continued)

Plant	Number of Tests		Annual Cost ($1000's)	
	Min.	Max.	Min.	Max.
QUARRIES CATEGORY (Continued)				
90. Spratt Sand & Gravel Ltd.				
91. St. Lawrence Cement Inc.				
92. Standard Aggregates Inc. - Brechin				
93. Standard Aggregates Inc. - Gore Bay				
94. Standard Aggregates Inc. - Hagersville				
95. Steeprock Calcite				
96. Steetley Quarry Products - Flamborough				
97. Steetley Quarry Products - Niagara Falls				
98. G. Tackaberry & Sons - Elizabethtown				
99. G. Tackaberry & Sons - Lowson Quarry				
100. G. Tackaberry & Sons - Willows Quarry				
101. G. Tackaberry & Sons - Jasper Quarry				
102. Taro Aggregates Limited				
103. 3M Canada Ltd.	3	9	1.8	5.4
104. R.W. Tomlinson Ltd.	1	4	$0.6	$2.4
105. United Aggregates Ltd. - Acton				
106. United Aggregates Ltd. - Gloucester				
107. Walker Industries - Ridgemont Quarries	1	4	0.6	2.4
108. Walker Industries - Vineland Quarries				
109. Walker Industries - Walker Bros.				
110. Warren Paving & Materials - Cornwall				
111. Warren Paving & Materials - Kingston				
112. Warren Paving & Materials - Gloucester	1	4	0.6	2.4
113. Warren Paving & Materials - Nepean				
114. Warren Paving & Materials - Montague				
115. Warren Paving & Materials - Stittsville				
116. Waterford Sand & Gravel Ltd.				
117. Woods's Sand and Gravel Ltd.	1	4	0.6	2.4
SUBTOTAL			$13.2	$51.0
SAND AND GRAVEL CATEGORY				
118. Frank Kling Ltd.	1	4	$0.6	$2.4
119. Kam Aggregates Limited	1	4	0.6	2.4
120. Lempiala Sand & Gravel Ltd.	1	4	0.6	2.4
121. Oxford Sand and Gravel Ltd.	1	4	0.6	2.4
122. Seeley & Arnill Aggregates Ltd.	1	4	0.6	2.4
123. Standard Aggregates, Inc. - Guelph	1	4	0.6	2.4
SUBTOTAL			$3.6	$14.4
TALC CATEGORY				
124. Canada Talc Ltd.	2	8	$1.2	$4.8
125. Luzenac Inc.	2	8	1.2	4.8
SUBTOTAL			$2.4	$9.6
SECTOR TOTALS			$56.4	$223.8

TABLE A.4: FLOW MEASUREMENT AND REPORTING COSTS FOR THE YEAR (IN $1,000's)

Plant	FLOW MEASUREMENT		REPORTING COSTS		
	CAPITAL COSTS	O & M COSTS	COMPUTER	INITIAL REPORTS	O & M COSTS
CEMENT CATEGORY					
1. LaFarge Canada Inc. - Bath		$4.3	$3.5	$3.5	$2.7
2. LaFarge Canada Inc. - Woodstock		4.3	3.5	3.5	2.7
3. Lake Ontario Cement		4.3	3.5	3.5	2.7
4. St. Lawrence Cement Inc.		2.2	3.5	2.5	1.8
5. St. Marys Cement Company - Bowmanville		4.3	3.5	3.5	2.7
6. St. Marys Cement Company - St. Marys		4.3	3.5	3.5	2.7
SUBTOTAL		$23.9	$21.0	$20.0	$15.3
CHEMICAL LIME CATEGORY					
7. BeachviLime Limited (East Plant)		$5.0	$3.5	$2.5	$1.8
8. BeachviLime Limited (West Plant)		5.0	3.5	2.5	1.8
9. Guelph DoLime Limited		5.0	3.5	2.5	1.8
10. Reiss Lime Co. of Canada Ltd.	$5.0	5.0	3.5	2.5	1.8
11. Steetley Quarry Products Inc.		15.0	3.5	2.5	1.8
12. Stelco Chemical Lime Works	5.0	24.3	3.5	2.5	1.8
SUBTOTAL	$10.0	$59.3	$21.0	$15.0	$10.8
CLAY AND SHALE CATEGORY					
13. Brampton Brick Ltd.		$1.1	$3.5	$1.5	$1.0
14. Canada Brick Company - Burlington		1.1	3.5	1.5	1.0
15. Canada Brick Company - Cooksville		1.1	3.5	1.5	1.0
16. Canada Brick Company - Gloucester		1.1	3.5	1.5	1.0
17. Canada Brick Company - Streetsville		1.1	3.5	1.5	1.0
SUBTOTAL		$5.5	$17.5	$7.5	$5.0
GRAPHITE CATEGORY					
18. Cal Graphite Corporation		$3.3	$3.5	$3.5	$2.4
19. North Coast Industries Ltd.		4.3	3.5	3.5	2.7
SUBTOTAL		$7.6	$7.0	$7.0	$5.1
GYPSUM CATEGORY					
20. CGC Limited		$4.3	$3.5	$3.5	$2.7
21. Domtar Construction Materials		4.3	3.5	3.5	2.7
22. Westroc Industries Limited		2.2	3.5	2.5	1.8
SUBTOTAL		$10.9	$10.5	$9.5	$7.2
MAGNESIUM CATEGORY					
23. Timminco Limited		$3.3	$3.5	$3.5	$2.4

TABLE A.4 (Continued)

Plant	FLOW MEASUREMENT		REPORTING COSTS		
	CAPITAL COSTS	O & M COSTS	COMPUTER	INITIAL REPORTS	O & M COSTS
QUARRIES CATEGORY					
24. Amherst Quarries (1969) Ltd.		$1.4	$3.5	$1.5	$1.0
25. B&M Carriers Ltd. - N. Plantagenet				0.5	
26. B&M Carriers Ltd. - S. Plantagenet				0.5	
27. Beaver Road Builders Ltd.				0.5	
28. Bertrand & Frere - L'Original				0.5	
29. Bertrand & Frere - Longueil				0.5	
30. Bertrand & Frere - S. Plantagenet				0.5	
31. Thomas Cavanagh Construction Ltd.				0.5	
32. Cayuga Materials & Construction Co.				0.5	
33. Cedarhurst Quarries & Crushing Ltd.				0.5	
34. Allan G. Cook Limited		1.4	3.5	1.5	1.0
35. Cornwall Gravel Co. - Cornwall		1.4	3.5	1.5	1.0
36. Cornwall Gravel Co. - Clarence		1.4	3.5	1.5	1.0
37. Cornwall Gravel Co. - Winchester				0.5	
38. Cruickshank Construction - Amherstview				0.5	
39. Cruickshank Construction - Kingston		1.4	3.5	1.5	1.0
40. Cruickshank Construction - Green Valley				0.5	
41. Cruickshank Construction - Lancaster				0.5	
42. Cruickshank Construction - Williamsburg				0.5	
43. Cruickshank Construction - Kenyon Twp.				0.5	
44. Dechan Const. Ltd.				0.5	
45. James Dick Construction Ltd.				0.5	
46. George W. Drummond Ltd.				0.5	
47. Dufferin Aggregates - Milton		1.4	3.5	1.5	1.0
48. Dunnville Rock Products Ltd.				0.5	
49. Dymond Clay Products Ltd.				0.5	
50. Flamboro Quarries Ltd.,		1.4	3.5	1.5	1.0
51. Fowler Construction Company Ltd.				0.5	
52. Francon Div. of Lafarge Canada Inc.		1.4	3.5	1.5	1.0
53. Gormley Aggregates Ltd. - Buckhorn				0.5	
54. Gormley Aggregates Ltd. - Garden Twp.		1.4	3.5	1.5	1.0
55. Griffin Brothers - Battersea Quarry				0.5	
56. Griffin Brothers - Joyceville Quarry				0.5	
57. Griffin Brothers - Lynns Quarry				0.5	
58. Halton Crushed Stone Ltd.				0.5	
59. Hard Rock Paving Co. Ltd.		1.4	3.5	1.5	1.0
60. Indusmin - Blue Mountain		1.4	3.5	1.5	1.0
61. Indusmin - Nephton				0.5	
62. Indusmin - Badgeley Island				0.5	
63. Karson Kartage & Konstruction Co.				0.5	

TABLE A.4 (Continued)

Plant	FLOW MEASUREMENT		REPORTING COSTS		
	CAPITAL COSTS	O & M COSTS	COMPUTER	INITIAL REPORTS	O & M COSTS
QUARRIES CATEGORY (Continued)					
64. George Kennedy				$0.5	
65. E.C. King Contracting				0.5	
66. M.J. Labelle Company Ltd.				0.5	
67. Markham Sand & Gravel - Brechin				0.5	
68. Markham Sand & Gravel - Sophiasburg Twp.				0.5	
69. H.J. McFarland Const. - Clarence Twp.				0.5	
70. H.J. McFarland Const. - Nepean				0.5	
71. H.J. McFarland Const. - Tyendinaga				0.5	
72. McKendry Quarries - Glen Quarry				0.5	
73. McKendry Quarries - Westbrook Quarry				0.5	
74. Milton Limestone		$1.4	$3.5	1.5	$1.0
7 Nelson Aggregate Company - Beamsville				0.5	
7 Nelson Aggregate Company - Burlington		1.4	3.5	1.5	1.0
77. Nelson Aggregate Company - Uhthoff		1.4	3.5	1.5	1.0
78. Nelson Granite				0.5	
79. Norfolk Quarries Company				0.5	
80. Permanent Concrete - Brockville Quarry				0.5	
81. Permanent Concrete - Cornwall Quarry		1.4	3.5	1.5	1.0
82. Permanent Concrete - Hawthorne Quarry				0.5	
83. Permanent Concrete - Navan Quarry				0.5	
84. Permanent Concrete - Orleans Quarry				0.5	
85. Permanent Concrete - Selby Quarry				0.5	
86. Permanent Concrete - Violet Road Quarry				0.5	
87. Port Colborne Quarries Ltd.				0.5	
88. Seeley & Arnill Aggregates Ltd.				0.5	
89. Smiths Construction Co. Arnprior Ltd.				0.5	
90. Spratt Sand & Gravel Ltd.				0.5	
91. St. Lawrence Cement Inc.				0.5	
92. Standard Aggregates Inc. - Brechin				0.5	
93. Standard Aggregates Inc. - Gore Bay				0.5	
94. Standard Aggregates Inc. - Hagersville				0.5	
95. Steeprock Calcite				0.5	
96. Steetley Quarry Products - Flamborough				0.5	
97. Steetley Quarry Products - Niagara Falls				0.5	
98. G. Tackaberry & Sons - Elizabethtown				0.5	
99. G. Tackaberry & Sons - Lowson Quarry				0.5	
100. G. Tackaberry & Sons - Willows Quarry				0.5	
101. G. Tackaberry & Sons - Jasper Quarry				0.5	
102. Taro Aggregates Limited				0.5	
103. 3M Canada Inc.		3.6	3.5	2.5	1.9

TABLE A.4 (Continued)

Plant	FLOW MEASUREMENT		REPORTING COSTS		
	CAPITAL COSTS	O & M COSTS	COMPUTER	INITIAL REPORTS	O & M COSTS
QUARRIES CATEGORY (Continued)					
104. R.W. Tomlinson Ltd.		1.4	3.5	1.5	1.0
105. United Aggregates Ltd. - Acton				0.5	
106. United Aggregates Ltd. - Gloucester				0.5	
107. Walker Industries - Ridgemont Quarries		1.4	3.5	1.5	1.0
108. Walker Industries - Vineland Quarries				0.5	
109. Walker Industries - Walker Bros.				0.5	
110. Warren Paving & Materials - Cornwall				0.5	
111. Warren Paving & Materials - Kingston				0.5	
112. Warren Paving & Materials - Gloucester		1.4	3.5	1.5	1.0
113. Warren Paving & Materials - Nepean				0.5	
114. Warren Paving & Materials - Montague				0.5	
115. Warren Paving & Materials - Stittsville				0.5	
116. Waterford Sand & Gravel Ltd.				0.5	
117. Woods's Sand and Gravel Ltd.		2.2	3.5	1.5	1.0
SUBTOTAL		$30.7	$70.0	$68.0	$20.9
SAND AND GRAVEL CATEGORY					
118. Frank Kling Ltd.		$1.4	$3.5	$1.5	$1.0
119. Kam Aggregates Limited		1.4	3.5	1.5	1.0
120. Lempiala Sand & Gravel Ltd.		1.4	3.5	1.5	1.0
121. Oxford Sand and Gravel Ltd.		1.4	3.5	1.5	1.0
122. Seeley & Arnill Aggregates Ltd.		1.4	3.5	1.5	1.0
123. Standard Aggregates, Inc. - Guelph		1.4	3.5	1.5	1.0
SUBTOTAL		$8.3	$21.0	$9.0	$6.0
TALC CATEGORY					
124. Canada Talc Ltd.		$2.2	$3.5	$2.5	$1.8
125. Luzenac Inc.		2.2	3.5	2.5	1.8
SUBTOTAL		$4.3	$7.0	$5.0	$3.6
SECTOR TOTALS	$10.0	$153.8	$178.5	$144.5	$76.3

TABLE A.5: TOTAL ESTIMATED COSTS RELATED TO THE MONITORING REGULATION (IN $1,000's)

Plant	O & M COSTS	CAPITAL COSTS	TOTAL COSTS		
			Min.	Point Est.	Max.
CEMENT CATEGORY					
1. LaFarge Canada Inc. - Bath	$73.8	$7.0	$64.7	$80.8	$97.0
2. LaFarge Canada Inc. - Woodstock	73.8	7.0	64.7	80.8	97.0
3. Lake Ontario Cement	73.8	7.0	64.7	80.8	97.0
4. St. Lawrence Cement	45.2	6.0	40.9	51.2	61.4
5. St. Marys Cement Company - Bowmanville	73.8	7.0	64.7	80.8	97.0
6. St. Marys Cement Company - St. Marys	73.8	7.0	64.7	80.8	97.0
SUBTOTAL	$414.3	$41.0	$364.2	$455.3	$546.3
CHEMICAL LIME CATEGORY					
7. BeachviLime Limited (East Plant)	$47.0	$6.0	$42.4	$53.0	$63.6
8. BeachviLime Limited (West Plant)	47.0	6.0	42.4	53.0	63.6
9. Guelph DoLime Limited	47.0	6.0	42.4	53.0	63.6
10. Reiss Lime Co. of Canada Ltd.	53.7	11.0	51.7	64.7	77.6
11. Steetley Quarry Products Inc.	57.0	6.0	50.4	63.0	75.6
12. Stelco Chemical Lime Works	66.3	11.0	61.9	77.3	92.8
SUBTOTAL	$317.9	$46.0	$291.1	$363.9	$436.6
CLAY AND SHALE CATEGORY					
13. Brampton Brick Ltd.	$15.0	$5.0	$16.0	$20.0	$23.9
14. Canada Brick Company - Burlington	15.0	5.0	16.0	20.0	23.9
15. Canada Brick Company - Cooksville	15.0	5.0	16.0	20.0	23.9
16. Canada Brick Company - Gloucester	15.0	5.0	16.0	20.0	23.9
17. Canada Brick Company - Streetsville	15.0	5.0	16.0	20.0	23.9
SUBTOTAL	$74.8	$25.0	$79.8	$99.8	$119.7
GRAPHITE CATEGORY					
18. Cal Graphite Corporation	$53.4	$7.0	$48.3	$60.4	$72.4
19. North Coast Industries Ltd.	76.5	7.0	66.8	83.5	100.1
SUBTOTAL	$129.8	$14.0	$115.1	$143.8	$172.6
GYPSUM CATEGORY					
20. CGC Limited	$72.4	$7.0	$63.6	$79.4	$95.3
21. Domtar Construction Materials	72.4	7.0	63.6	79.4	95.3
22. Westroc Industries Limited	44.8	6.0	40.6	50.8	61.0
SUBTOTAL	$189.7	$20.0	$167.8	$209.7	$251.6
MAGNESIUM CATEGORY					
23. Timminco Ltd.	$49.3	$7.0	$45.1	$56.3	$67.6

TABLE A.5 (Continued)

Plant	O & M COSTS	CAPITAL COSTS	TOTAL COSTS		
			Min.	Point Est.	Max.
QUARRIES CATEGORY					
24. Amherst Quarries (1969) Ltd.	$3.7	$1.4	$4.0	$5.1	$6.1
25. B&M Carriers Ltd. - N. Plantagenet	3.7	1.4	4.0	5.1	6.1
26. B&M Carriers Ltd. - S. Plantagenet	3.7	1.4	4.0	5.1	6.1
27. Beaver Road Builders Ltd.	3.7	1.4	4.0	5.1	6.1
28. Bertrand & Frere - L'Original	3.7	1.4	4.0	5.1	6.1
29. Bertrand & Frere - Longueil	3.7	1.4	4.0	5.1	6.1
30. Bertrand & Frere - S. Plantagenet	3.7	1.4	4.0	5.1	6.1
31. Thomas Cavanagh Construction Ltd.	3.7	1.4	4.0	5.1	6.1
32. Cayuga Materials & Construction Co.	3.7	1.4	4.0	5.1	6.1
33. Cedarhurst Quarries & Crushing Ltd.	3.7	1.4	4.0	5.1	6.1
34. Allan G. Cook Limited	3.7	1.4	4.0	5.1	6.1
35. Cornwall Gravel Co. - Cornwall	3.7	1.4	4.0	5.1	6.1
36. Cornwall Gravel Co. - Clarence	3.7	1.4	4.0	5.1	6.1
37. Cornwall Gravel Co. - Winchester	3.7	1.4	4.0	5.1	6.1
38. Cruickshank Construction - Amherstview	3.7	1.4	4.0	5.1	6.1
39. Cruickshank Construction - Kingston	3.7	1.4	4.0	5.1	6.1
40. Cruickshank Construction - Green Valley	3.7	1.4	4.0	5.1	6.1
41. Cruickshank Construction - Lancaster	3.7	1.4	4.0	5.1	6.1
42. Cruickshank Construction - Williamsburg	3.7	1.4	4.0	5.1	6.1
43. Cruickshank Construction - Kenyon Twp.	3.7	1.4	4.0	5.1	6.1
44. Dechan Const. Ltd.	3.7	1.4	4.0	5.1	6.1
45. James Dick Construction Ltd.	3.7	1.4	4.0	5.1	6.1
46. George W. Drummond Ltd.	3.7	1.4	4.0	5.1	6.1
47. Dufferin Aggregates - Milton	3.7	1.4	4.0	5.1	6.1
48. Dunnville Rock Products Ltd.	3.7	1.4	4.0	5.1	6.1
49. Dymond Clay Products Ltd.	3.7	1.4	4.0	5.1	6.1
50. Flamboro Quarries Ltd.,	3.7	1.4	4.0	5.1	6.1
51. Fowler Construction Company Ltd.	3.7	1.4	4.0	5.1	6.1
52. Francon Div. of Lafarge Canada Inc.	3.7	1.4	4.0	5.1	6.1
53. Gormley Aggregates Ltd. - Buckhorn	3.7	1.4	4.0	5.1	6.1
54. Gormley Aggregates Ltd. - Carden Twp.	3.7	1.4	4.0	5.1	6.1
55. Griffin Brothers - Battersea Quarry	3.7	1.4	4.0	5.1	6.1
56. Griffin Brothers - Joyceville Quarry	3.7	1.4	4.0	5.1	6.1
57. Griffin Brothers - Lynns Quarry	3.7	1.4	4.0	5.1	6.1
58. Halton Crushed Stone Ltd.	3.7	1.4	4.0	5.1	6.1
59. Hard Rock Paving Co. Ltd.	3.7	1.4	4.0	5.1	6.1
60. Indusmin - Blue Mountain	16.7	5.0	17.3	21.7	26.0
61. Indusmin - Nephton	0.0	0.5	0.4	0.5	0.6
62. Indusmin - Badgeley Island	0.0	0.5	0.4	0.5	0.6
63. Karson Kartage & Konstruction Co.	3.7	1.4	4.0	5.1	6.1

TABLE A.5 (Continued)

Plant	O & M COSTS	CAPITAL COSTS	TOTAL COSTS Min.	TOTAL COSTS Point Est.	TOTAL COSTS Max.
QUARRIES CATEGORY (Continued)					
64. George Kennedy	$3.7	$1.4	$4.0	$5.1	$6.1
65. E.C. King Contracting	3.7	1.4	4.0	5.1	6.1
66. M.J. Labelle Company Ltd.	3.7	1.4	4.0	5.1	6.1
67. Markham Sand & Gravel - Brechin	3.7	1.4	4.0	5.1	6.1
68. Markham Sand & Gravel - Sophiasburg Twp.	3.7	1.4	4.0	5.1	6.1
69. H.J. McFarland Const. - Clarence Twp.	3.7	1.4	4.0	5.1	6.1
70. H.J. McFarland Const. - Nepean	3.7	1.4	4.0	5.1	6.1
71. H.J. McFarland Const. - Tyendinaga	3.7	1.4	4.0	5.1	6.1
72. McKendry Quarries - Glen Quarry	3.7	1.4	4.0	5.1	6.1
73. McKendry Quarries - Westbrook Quarry	3.7	1.4	4.0	5.1	6.1
74. Milton Limestone	3.7	1.4	4.0	5.1	6.1
75. Nelson Aggregate Company - Beamsville	3.7	1.4	4.0	5.1	6.1
76. Nelson Aggregate Company - Burlington	3.7	1.4	4.0	5.1	6.1
77. Nelson Aggregate Company - Uhthoff	3.7	1.4	4.0	5.1	6.1
78. Nelson Granite	3.7	1.4	4.0	5.1	6.1
79. Norfolk Quarries Company	3.7	1.4	4.0	5.1	6.1
80. Permanent Concrete - Brockville Quarry	3.7	1.4	4.0	5.1	6.1
81. Permanent Concrete - Cornwall Quarry	3.7	1.4	4.0	5.1	6.1
82. Permanent Concrete - Hawthorne Quarry	3.7	1.4	4.0	5.1	6.1
83. Permanent Concrete - Navan Quarry	3.7	1.4	4.0	5.1	6.1
84. Permanent Concrete - Orleans Quarry	3.7	1.4	4.0	5.1	6.1
85. Permanent Concrete - Selby Quarry	3.7	1.4	4.0	5.1	6.1
86. Permanent Concrete - Violet Road Quarry	3.7	1.4	4.0	5.1	6.1
87. Port Colborne Quarries Ltd.	3.7	1.4	4.0	5.1	6.1
88. Seeley & Arnill Aggregates Ltd.	3.7	1.4	4.0	5.1	6.1
89. Smiths Construction Co. Arnprior Ltd.	3.7	1.4	4.0	5.1	6.1
90. Spratt Sand & Gravel Ltd.	3.7	1.4	4.0	5.1	6.1
91. St. Lawrence Cement Inc.	3.7	1.4	4.0	5.1	6.1
92. Standard Aggregates Inc. - Brechin	3.7	1.4	4.0	5.1	6.1
93. Standard Aggregates Inc. - Gore Bay	3.7	1.4	4.0	5.1	6.1
94. Standard Aggregates Inc. - Hagersville	3.7	1.4	4.0	5.1	6.1
95. Steeprock Calcite	3.7	1.4	4.0	5.1	6.1
96. Steetley Quarry Products - Flamborough	3.7	1.4	4.0	5.1	6.1
97. Steetley Quarry Products - Niagara Falls	3.7	1.4	4.0	5.1	6.1
98. G. Tackaberry & Sons - Elizabethtown	3.7	1.4	4.0	5.1	6.1
99. G. Tackaberry & Sons - Lowson Quarry	3.7	1.4	4.0	5.1	6.1
100. G. Tackaberry & Sons - Willows Quarry	3.7	1.4	4.0	5.1	6.1
101. G. Tackaberry & Sons - Jasper Quarry	3.7	1.4	4.0	5.1	6.1
102. Taro Aggregates Limited	3.7	1.4	4.0	5.1	6.1
103. 3M Canada Ltd.	69.4	6.0	60.3	75.4	90.5

TABLE A.5 (Continued)

	Plant	O & M COSTS	CAPITAL COSTS	TOTAL COSTS		
				Min.	Point Est.	Max.
	QUARRIES CATEGORY (Continued)					
104.	R.W. Tomlinson Ltd.	$3.7	$1.4	$4.0	$5.1	$6.1
105.	United Aggregates Ltd. - Acton	3.7	1.4	4.0	5.1	6.1
106.	United Aggregates Ltd. - Gloucester	3.7	1.4	4.0	5.1	6.1
107.	Walker Industries - Ridgemont Quarries	3.7	1.4	4.0	5.1	6.1
108.	Walker Industries - Vineland Quarries	3.7	1.4	4.0	5.1	6.1
109.	Walker Industries - Walker Bros.	3.7	1.4	4.0	5.1	6.1
110.	Warren Paving & Materials - Cornwall	3.7	1.4	4.0	5.1	6.1
111.	Warren Paving & Materials - Kingston	3.7	1.4	4.0	5.1	6.1
112.	Warren Paving & Materials - Gloucester	3.7	1.4	4.0	5.1	6.1
113.	Warren Paving & Materials - Nepean	3.7	1.4	4.0	5.1	6.1
114.	Warren Paving & Materials - Montague	3.7	1.4	4.0	5.1	6.1
115.	Warren Paving & Materials - Stittsville	3.7	1.4	4.0	5.1	6.1
116.	Waterford Sand & Gravel Ltd.	3.7	1.4	4.0	5.1	6.1
117.	Woods's Sand and Gravel Ltd.	3.7	1.4	4.0	5.1	6.1
	SUBTOTAL	$415.3	$138.0	$442.6	$553.3	$664.0
	SAND AND GRAVEL CATEGORY					
118.	Frank Kling Ltd.	$16.5	$5.0	$17.2	$21.5	$25.8
119.	Kam Aggregates Limited	16.5	5.0	17.2	21.5	25.8
120.	Lempiala Sand & Gravel Ltd.	16.5	5.0	17.2	21.5	25.8
121.	Oxford Sand and Gravel Ltd.	16.5	5.0	17.2	21.5	25.8
122.	Seeley & Arnill Aggregates Ltd.	16.5	5.0	17.2	21.5	25.8
123.	Standard Aggregates, Inc. - Guelph	16.5	5.0	17.2	21.5	25.8
	SUBTOTAL	$99.2	$30.0	$103.3	$129.2	$155.0
	TALC CATEGORY					
124.	Canada Talc Ltd.	$46.2	$6.0	$41.7	$52.2	$62.6
125.	Luzenac Inc.	46.2	6.0	41.7	52.2	62.6
	SUBTOTAL	$92.3	$12.0	$83.5	$104.3	$125.2
	SECTOR TOTALS	$1,782.6	$333.0	$1,692.5	$2,115.6	$2,538.7

NOTE: Average costs per plant in each category are given in brackets. Minimum Total Cost is 20% below the Point Estimate, while Maximum Total Cost is 20% above the Point Estimate.

SOURCE: Tables A.1, A.2, A.3 and A.4.

PROFILES OF INDUSTRY CATEGORIES IN THE INDUSTRIAL MINERALS SECTOR

B.1 Cement

The Canadian cement industry has the capacity to produce about 14.77 million tonnes per year (Mt/y) (Energy, Mines and Resources Canada, 1989). When cement is combined with water, sand and suitable aggregates in proper proportion it becomes a useful binder, "cementing" the materials together to form concrete. Cement plants are located near the source of their raw material, limestone, where there is with access to bulk shipping facilities (e.g. harbours). Because cement has a low ratio of value to weight, each plant supplies regional market areas. Cement is produced by igniting a mixture of raw materials consisting predominantly of limestone (84%), and varied quantities of clay, shale, gypsum, sand or silica, and iron oxide in a kiln to form a clinker. The clinker is ground to a fine powder with additional quantities of gypsum and bagged for shipment. Approximately 1.8 tonnes of raw material are required to produce 1 tonne of portland cement (Ontario Ministry of Natural Resources, 1989).

Ontario's 1987 cement production of 5.9 Mt accounted for 44% of Canada's production and 0.5% of world cement output (Canada, 1989, Canadian Minerals Yearbook). During 1987, 1,122 Ontario residents were employed in cement plants located at Bath, Bowmanville, Mississauga, Picton, St. Marys and Woodstock. The St. Lawrence Cement plant in Mississauga has one of the largest kilns in North America. This plant and Lake Ontario Cement's four-kiln plant at Picton are among the largest in Northern America in terms of clinker capacity (Mines and Resources Canada, 1989).

The majority of cement firms are vertically integrated in that they own lime quarries and "ready mixed" concrete operations (Ontario, 1989, Lime Industries of Ontario, Volume 1). Consequently, many of the companies domiciled in Ontario have a varied product mix which may include ready-mix concrete, stone, cement, aggregates and concrete products. The larger of these companies operate plants which are located across the province and in some cases, elsewhere in Canada and the United

States. Some firms have attempted to enter the U.S. market through acquisitions of U.S. based firms, plants and distribution networks.

Cement production in Ontario in 1986 was 4.8 Mt, an 18% increase over the 1985 production of 4.1 Mt. The increase in the value of production was even greater, with sales of C$329 million amounting to 28% more than 1985 revenues of C$256 million. This was due to a 12.57% rise in the unit value which rose from C$70.66 per tonne to C$79.54 per tonne (Ontario Mineral Score 1988, 1989). The price of cement is closely linked to construction and capital projects activities in Ontario. Over the last 20 years the price per tonne of cement has generally averaged C$77/tonne (Ontario Ministry of Northern Development and Mines, 1989).

Canada's cement exports, which were chiefly to the U.S., amounted to C$235 million in 1987 and C$233 million in 1986. Imports of cement into Canada originated primarily in the U.S. and totalled C$19 million in 1987 and C$27 million in 1986 (Energy, Mines and Resources Canada, 1989).

B.2 Chemical Lime

Lime is often referred to a wide variety of calcareous materials used in construction and building materials. More specifically, lime consists of burned or calcined limestone and its derivatives. Lime (CaO or CaCO.MgO) is produced when limestones are heated to dissociation temperatures and kept at those temperatures long enough for carbon dioxide to be driven off. Limestones composed predominantly of $CaCO_3$ are heated to 898°C and those of $MgCO_3$ to 402°C (Energy, Mines and Resources Canada, 1989).

Crushed limestone is produced exclusively from open quarries. In 1988, Canada's lime production (calcining) capacity was estimated at 3.5 Mt/y. However, the plants only operated at 71% of that capacity during the year (Energy, Mines and Resources Canada, 1989). Canada's lime production in 1987 was 2.4 Mt, valued at C$179.8 million.

Ontario lime production amounted to 1.5 Mt or 63% Canada's 1987 production. Ontario lime manufacturers calcination operation provided employment for 384 people in 1987, in addition to 1,944 persons that worked directly in limestone quarries (Ontario Ministry of Northern Development and Mines, 1989). Lime operations are located relatively close to lime users such as cement plants, steel mills and pulp and paper mills.

Energy supply and the availability of high-quality raw materials are also important factors influencing the location of a lime plant. Quarries in Quebec and Ontario jointly produce over 80% of Canada's annual lime production. In Ontario, lime producers are concentrated in the East and at lime deposits along the Niagara Escarpment (Ontario Ministry of Natural Resources, 1989).

Canadian lime markets currently exhibit a dual structure. First, a "captive" or vertically integrated market where quarries and plants send all output to parent firms manufacturing operations absorbs 26% of production. Second, a merchant or open market accounts for the remainder, of which Ontario firms supply 50% of the total. Lime exports, which totalled 163,800 tonnes(t) in 1987, have declined steadily over the last 10 years (Energy, Mines and Resources Canada, 1989). Export shipments were mainly to the U.S. from British Columbia, Quebec and Ontario. While lime imports have been stable, imports totalling 44,300 t in 1987, went mainly to Alberta (18%) and Ontario (56%) (Energy, Mines and Resources Canada, 1989). There is horizontal integration in the Ontario lime industry, and recent acquisition of quarries by Dofasco has further concentrated ownership in the industry.

Canada's domestic consumption of lime is forecast to increase by 2% over the next three years (Energy, Mines and Resources Canada, 1989). Although the current use of lime for SO_2 control in scrubbers accounts for only a small percentage of total lime purchases, the intent to construct SO_2 control facilities is likely to stimulate a 25% increase in demand for lime for environmental uses by 1993 (Energy, Mines and Resources Canada, 1989).

B.3 Clay and Shale

Clays comprise a diverse group of minerals used in making structural products including bricks, tiles, and drainage pipes and other ceramic products. Historically, Ontario accounts for 60% of Canada's annual clay production, by value, which in 1987, totalled C$199.4 million (Energy, Mines and Resources Canada, 1989). In that year, the sector employed 822 people in Ontario, 34 of which worked in shale quarries.

The commercial value of clays and shales, which have similar chemical compositions, may vary according to strength, plasticity, porosity and absorption, fire colour, shrinkage, refractoriness and vitrication range.

In 1984, 464 million brick were produced in Ontario, of which over 90% were used in residential building construction in southern Ontario.

Clays minerals, mostly recovered from surface deposits, fall into one of four major groups: the Kaolinite, smectite, clay-mica and chlorite. Canadian clay producers usually produce one clay type, which is a reflection of the geographic distribution of the clay deposits. Quebec, Ontario, Manitoba and parts of Saskatchewan are rich in Kaolin deposits, although in 1988 there was no commercial production of this type in Canada. Bentonite and fire clays are predominant in the Maritimes and elsewhere. The majority of the clay producing firms are small to medium in size and are domestically controlled.

Imported clays, which amounted to 710,356 t during the first nine months of 1988, were used in the production of refractors and in the making of sanitaryware, whiteware, electrical porcelain, art pottery and other fine products by plants located across the country (Energy, Mines and Resources Canada, 1989). Imported Kaolin clays are used by the pulp and paper industry to make specialty and coated papers. The unit prices for the various domestically-produced clays have increased during recent years. For example, Kaolin paper grade rose from US$350 in 1987 to US$450 in 1988. The value of production rose from C$30.6 million in 1969 to C$122.2 million in 1988.

Much of the growth in Canadian demand, particularly for specialty clays, has been met by increasing clay imports. However, three firms located in Ontario, Saskatchewan and British Columbia are presently undertaking mine development projects that may eventually supply most, if not all, of Canada's domestic demand for Kaolin, now supplied entirely by imports.

B.4 Graphite

Graphite is used primarily in the metallurgy and refractory industries. It is also used as electrodes, lubricants, pencil "leads", and brake liners. Canada's graphite consumption in 1987 was 14,217 t up 35% from 13,757 t in 1986. Growth in graphite consumption is expected to continue as long as there is growth in the production of iron and steel and of base metals which are the two principal graphite users.

Graphite is composed of hexagonal carbon (C) crystals and is typically silvery grey to black in colour. Graphite is classified by particle size as amorphous, flake or crystalline.

Essentially all of Canada's graphite production, which was 455 tonnes in 1986, is composed of the less desirable flake classification. The most common type of graphite found in Ontario is flake graphite. The entire production was exported to American parent companies by their Canadian subsidiaries (Energy, Mines and Resources Canada, 1989). In turn, Canada imported C$3.6 million worth of higher-quality graphite in 1987. Ninety per cent of Canada's graphite imports came from the U.S. In the first nine months of 1988, Canada imported over C$2.3 million of crude graphite largely from American producers. Crude graphite is consumed chiefly in Ontario (70%) and Quebec (15%) (Energy, Mines and Resources Canada, 1989).

Over the last several years, there has been a considerable exploration work for graphite in Quebec and Ontario. Two firms have developed new graphite mines in Ontario, one located at Kearney and the other in Maria Township. Together, these mines have an anticipated capacity of 1,300 to 1,350 tonnes/day (t/d), and both are expected to commence operations within a year. Six companies located in Quebec and Ontario account for substantially all of Canada's graphite production.

B.5 Gypsum

Gypsum is hydrous calcium sulphate ($CaSO_4.2H_2O$) which releases three-quarters of its chemically bound water when calcined at temperatures between 120° and 150° Centigrade. Canada is the world's second largest producer of crude gypsum, after Ontario's production of 1.439 Mt in 1987 accounted for 15% of Canada's production. By comparison, Atlantic Canada produces 75% of the country's annual crude gypsum shipments. Gypsum mines in Ontario provided 217 people with employment in 1987.

Gypsum is used in the manufacture of stucco and plaster of paris but, by far, the primary product is wallboard or "sheet rock". In 1987, total shipments of gypsum products were 8.5 Mt. The demand for gypsum is closely linked to the requirements of the cement and construction industries. The cement industry alone consumes 500,000 t/y of finely ground gypsum, which is used as a set inhibitor in portland cement.

Gypsum production in Ontario is situated close to demand centres because the primary product, wallboard, is bulky, low valued, fragile and incurs high transportation costs. The majority of Canadian gypsum producers are subsidiaries of American gypsum producers (Energy, Mines and Resources Canada, 1989).

Gypsum mines are generally vertically integrated with wallboard producers. Domtar Construction Division operates a mine and two wallboard plants at Caledonia. Canadian Gypsum Company operates a mine and wallboard plant at Hagersville while Westroc Industries Limited operates a mine at Drumbo which supplies a wallboard plant in Mississauga. In 1988, Canada exported 72.6 million m^2 of wallboard to the USA, down 10% from the previous year.

Over the next several years, demand for gypsum products is expected to soften as construction in Quebec and Ontario slows down. In spite of such predictions by the Conference Board of Canada, the Canadian Construction Association forecast an annual 4.5% rise in non-residential construction expenditures between 1986 and 1995 (Energy, Mines and Resources Canada, 1989). Large public works capital projects are also projected to increase as Canada's sewage networks and other large infrastructures become due for renovation. Low price, ease of installation and other qualities of the wallboard, coupled by growth in commercial and residential renovation activity will smooth out the peaks and troughs in gypsum demand (Energy, Mines and Resources Canada, 1989).

B.6 Magnesium

Magnesium (Mg) is significant as an alloying agent, with the aluminum industry accounting for 51.7% of magnesium production. Magnesium is also used in die cast products (11.3%), in steel desulphurization (9.3%), nodular iron (6.0%), metal reduction (3.7%), wrought products (3.6%), electro-chemical (3.4%), chemical and gravity casting. Ontario produced Canada's entire primary magnesium production of 9.4 Mt in 1987 valued at C$41.9 million (Ontario Ministry of Northern Development and Mines, 1989). Timminco Limited of Haley Station, Ontario, is Canada's only producer of primary magnesium from dolomitic ore.

Demand for magnesium has apparently declined in recent years. In 1988, Timminco reduced production from 9,000 t/y to 6,000 t/y rather than increase its mining and production capacity to 15,000 t/y as had been planned (Energy, Mines and Resources Canada, 1989). Canada's magnesium production currently ranks seventh after the United States and U.S.S.R.

In Quebec, Norsk Hydro AS, of Becancour, imported 30,000 t of high-grade magnesite feedstock ($MgCO_3$) from the People's Republic of China for refining into magnesium metal. Although this plant will initially operate to produce 40,000 t/d of magnesium, it will eventually have the capacity to process 240,000 t/y of magnesite feedstock to 60,000 t/y of magnesium (Toronto Star, September 20, 1989, pp B16). The first ingots from this plant were to be cast in Fall 1989. Canada's annual production will increase to over 150,000 t/y of Magnesium metal when other projects planned across the country become operational by 1994. Then Canada's production would be the largest in the world.

The market for magnesium is currently robust as magnesium inventories in 1988 were low. It is expected that the demand for magnesium through the 1990's will increase on average by 3.5% annually (Energy, Mines and Resources Canada, 1989). This demand will remain strong as long as aluminum maintains its price competitiveness relative to other structural metals. Increased price competition is also envisaged as magnesium producers, now under capacity, increase production to balance demand (Energy, Mines and Resources Canada, 1989). Less efficient producers are expected to increase productivity or be forced to curtail their operations (Ontario, 1988 Ontario Mineral Score: 1987).

B.7 Quarries

Quarry operators extract a wide range of structural materials and which are grouped mainly by their method of production. Quarries include a wide range of operations that mine quartz and feldspar, slate, limestone, sandstone, marble, crushed stone and granite, primarily for construction. In 1987, 2,132 Ontario residents were directly employed in this sector and produced 61,704 t of materials valued at C$272 million (Ontario Ministry of Northern Development and Mines, 1989).

B.8 Sand and Gravel

Sand and gravel are mainly used as in concrete aggregate, highway construction, and to a lesser extent in sanitary landfills for cover, winter road maintenance and for other purposes. Ontario is the largest sand and gravel producer in Canada, accounting for 30% of the national production. Ontario accounts for the largest consumption of sand and gravel in Canada.

Production of sand and gravel has increased steadily over the last several years, with year-to-year increases of as much as 10% reported (Ontario Ministry of Northern Development and Mines, 1988). The rapid growth of sand and gravel production in Ontario is a consequence of growth in construction activity in the 1970's and late 1980's. In addition, 2,796 persons were employed in Ontario sand and gravel pits in 1987 (Ontario Ministry of Northern Development and Mines, 1988).

In 1988, 99,650 t of sand and gravel, valued at C$289 million, were produced in Ontario. Although quantity of production was 4% higher than in the previous year, total revenue was C$5.7 million less. This was due to lower prices in 1988 (Ontario Ministry of Northern Development and Mines, 1989). Sustained growth in construction and urban expansion projects have increased the demand for sand and gravel. This demand will continue to grow with the rise in population, housing demand, and construction. Sufficient sand and gravel resources exist locally to meet Ontario's future demands. However, the majority of the aggregate deposits within, or close to, major urban centres have been used up. Sand and gravel are normally consumed close to where they are produced because of their bulkiness, weight and high transportation costs. Access to some of the remaining low cost deposits may be circumscribed because of their geographic distribution, zoning, environmental restrictions and quality requirements (Ontario, 1982, Ontario Industrial Minerals).

B.9 Talc

Talc is a hydrous magnesium silicate ($Mg_3Si_4O_{10}(OH)_2$), composed of water (4.8% by weight), manganeol oxide (31.7%) and silica dioxide (63.5%). In situ however, talc's composition may vary as it is usually intimately associated with numerous minerals such as dolomite, quartz and serpentine (Canada, 1988, Canadian Mineral Yearbook: 1987 Review and Outlook). Talc is used mainly as a bulk filler and coating pigment in paper. Additional uses of talc include reenforcement fillers in plastics and ceramics, pitch control in pulp, dusting agent in asphalt roofing, rubber products, paints and in pharmaceutical products (Ontario Ministry of Northern Development and Mines, 1988). The pulp and paper industry accounts for 37% of Canada's consumption of talc, while asphalt roofing and paint manufacturing, use 31% and 12% respectively.

In Ontario, talc is produced in the Madoc area from hydrothermal replacements in dolomite, and from talc-magnesite deposits south of Timmins. The talc is recovered by a floatation process and then fine-ground to a high purity, flakey-layered product. Ontario's talc production has increased substantially during the 1980's as a result of new discoveries and improved and expanded processing facilities. There are two talc producers in Ontario, both with maximum capacities in excess of 50,000 t/y. Annual production of 16,000 t in 1980 increased to 58,000t by 1987, valued at C$1.7 million and C$9.6 million respectively. And in 1987, 108 persons in Ontario were employed in the production of talc (Ontario Ministry of Northern Development and Mines, 1988).

Quebec and Ontario jointly account for Canada's entire talc production. In 1987, Ontario accounted for 63% of Canada's total talc production of 141,223 t. Canadian talc consumption in 1986, the latest year for which figures are available, was 64,640 t. Talc imports during the first nine months of 1987 were 36,196 t valued at C$6.3 million.

The demand for talc in most of the consumer industries is expected to increase slightly in the medium- to long-term, 2.5 - 3.5% in ceramics, 3-4% in paint and asphalt roofing, 6% in plastics, and 7% in pulp and paper (Energy, Mines and Resources Canada, 1988). An appreciable increase in consumption is also expected in the insecticide industry. However, in spite of the upward pressure on demand, prices which rose 8.3% in 1987, are expected to fluctuate as new supplies are brought to production. Quality, method of processing, transport costs and consumer specifications are the chief factors that influence the price of talc. The prices of the higher-quality talc products, for which demand is greatest, are expected to rise relative to prices of other grades (Energy, Mines and Resources Canada, 1988).

ADDITIONAL INFORMATION
PROVIDED BY COMPANIES AND INDUSTRY GROUPS

Independent estimates of anticipated costs of monitoring have been provided for four plants in the Chemical Lime category. An estimate of a monitoring program to be carried out be consultants, submitted too late for incorporation into the body of the report, provides an independent assessment of total costs to plants in the Cement category.

BeachviLime (East and West Plants) and Guelph DoLime

Alternative estimates of operating costs of monitoring for BeachviLime Limited (East and West plants) and Guelph DoLime Limited were provided by a representative of BeachviLime. (S. Francois, June 20, 1989. Memorandum to K. Donyina and L. Coplan.) The anticipated of operating costs of monitoring, apart from the costs associated with flow measurement, total $123,100 for these three plants. This compares with a point estimate of $126,000 in costs for these plants as reported in Tables A.1 through A.4. An Estimate of $5,000 per plant for operating costs for flow measurement was provided separately by the corporate representative and is included in the total O & M costs reported in Table A.5.

Stelco Chemical Lime Works

An estimate the cost of monitoring for the Stelco Chemical Lime Works, reported by a representative of Stelco Inc., totals $232,940. (J.D. Phyper, May 16, 1989. Letter to Mr. Kwasi Donyina, MISA Industrial Section.) By comparison, the point estimate of anticipated costs of monitoring for this plant, shown in Table A.5, totals $77,300 and includes $11,000 for capital costs and $66,300 for O & M costs.

The capital cost anticipated by the company totals $92,000, of which $75,000 is allotted for the lease of a trailer at the facility together with office furniture and a heater. The cost for office space and equipment is not included in the body of the report. In addition, the company expects to spend $10,000 for computer equipment as compared to $3,500 shown in Table A.4.

Stelco also reports that it expects to spend $140,940 on O & M costs of monitoring. Of this amount, $73,200 reflects anticipated labour costs for sample collection, preparation and shipping; for data entry; and for supervision and administration. The expected costs for the same activities, as reported in Tables A.1 and A.4, total $17,300. Another $20,600 is allotted for the transport of samples to a laboratory in Toronto with the use of a leased vehicle. The mileage and leasing fees amount to $132 per trip. The comparable estimate in Table A.1, which is based on the use of courier services, totals $6,200.

Cement Category

The Canadian Portland Cement Association (CPCA) provided an estimate of total costs to plants in the Cement category of a monitoring program to be carried out by consultants. (P.W. Waisanen, September 22, 1989. Letter to L. Coplan, Ministry of the Environment.) Capital costs for monitoring equipment, such as automatic samplers and flow measurement devices, and other costs relating to installation of equipment are estimated to total $340,000 for the sector. Of this amount, $120,000 is budgeted for equipment for the monitoring of "inlet water" which is not required by the Regulation. In addition, initial reports for the six cement plants are expected to cost $22,000 in total. Anticipated capital costs for the six plants in the Cement category, as shown in Tables A.4 and A.5, total $41,000, but this figure does not reflect the new information concerning the installation of monitoring equipment which was discussed above.

Total O & M costs of monitoring for the six cement plants are expected to total $370,000, including laboratory analyses and toxicity testing of inlet water. The anticipated costs for analytical testing of inlet water are not provided, but this component could amount to $85,400 based on pro-rating costs by the number of sampling points. Excluding analyses of inlet water sampling points, it would appear that the CPCA anticipates total O & M costs of $284,600. By comparison, Table A.5 shows total anticipated O & M costs of $414,300 for the six plants.

It would appear that the additional capital expenditures would reduce the labour requirement for sampling and other analytical functions, resulting in lower expected O & M costs. This view is consistent with discussions in Chapter 3 of this report. Excluding costs associated with monitoring of inlet water sampling points, the total cost of monitoring for the six cement plants, as reported by the CPCA, amounts to $504,600. Although higher than the point estimate for this category shown in Table A.5, the CPCA figure is less than the corresponding maximum value in this table.